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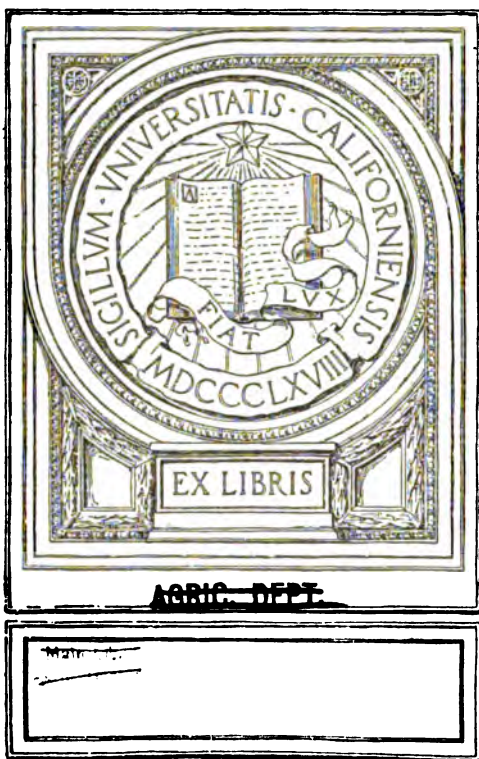
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*of F. J. Miskow College of Agriculture
California, U.S.A*

With compliments from the writer

REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS
DURING THE YEAR 1886,
WITH METHODS OF
PREVENTION AND REMEDY.

TENTH REPORT.

BY

ELEANOR A. ORMEROD, F.R. MET. Soc., &c.,

CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY; HON. AND CORR. MEM.
OF ROYAL AG. AND HORT. SOC., S. AUSTRALIA; CORR. MEM. OF ALBANY INSTITUTE, "A.S.", &c.

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~~Mem. LPA~~
~~AGRIC. DEPT.~~

TO THE
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PREFACE.

1886 will always be notable agriculturally as the year of the first appearance of the Hessian Fly, *Cecidomyia destructor*, in Great Britain as a destructive corn pest. Where it has come from remains still to be made out, but we see from our own observations of the last few months that there are means of prevention of the multiplication of this pest, easily available in this country, by which we might reasonably expect to keep it in moderate bounds, *if these measures are used*. If they are not, the example of its rapid spread over about two-thirds of European Russia, so that since its first observation in that country in 1879 it has become the most destructive crop-scurge of the land, shows what we have to fear.

The disease known as "Tulip-root" in Oats and also Warble attack to Horses are points which have been little noticed previously; and in the reports now submitted to my readers it will be observed that I have endeavoured as far as possible to limit them to attacks which have either not been previously observed in this country, or have not been as fully reported on as their importance deserved, or, in the case of some of our regular old-standing crop-pests, to information on points of habits and means of prevention not previously contributed.

But whilst the common crop-attacks of "Wireworm," "Turnip Fly," "Daddy Longlegs" grubs, and possibly some others which have already been reported on at length, have been little entered on in this my Tenth Report, there is one subject of national importance, home and colonial, which ought not to be passed over in silence. This is the continued loss in some districts from overwhelming presence of House Sparrows. Further information based on sound observation has continued to come in regarding the injury caused to vegetable, fruit, and corn crops by fostering this most mischievous bird, and in the trouble in prospect of the presence of Hessian Fly, its preponderance is likely to be most

baneful by driving away birds of a truly insectivorous nature. I have not the slightest hesitation in advising every farmer, by every means lawfully in his power, to have every House Sparrow and every nest of eggs of House Sparrow destroyed, and their places of resort for breeding cleared as much as possible.

In the constantly increasing work of my own special department, information is not unfrequently sought regarding foreign and colonial insect-attacks, and likewise it is now necessary to be prepared in this country to meet as best we may the attacks of crop-insects hitherto unnoticed here. Relatively to these points I have been greatly favoured by skilled correspondents,—I may venture to say many friends, in many distant lands,—who have not only helped me by personal communication, but by extensive and valuable gifts of their published writings, thus placing in my hands the best information up to the present time, which in many cases it would have been almost impossible to possess, save through the courtesy of the authors.

In regard to specially-conferred information, I have endeavoured in every case to acknowledge it as called for in the following pages, but the various treatises sent me are of such great service in my work that I desire to mention with sincere thanks the names of some of those to whom I am the most indebted. In Canada I am especially under obligation to Mr. J. Fletcher, Consulting Entomologist of the Department of Agriculture, and to Prof. W. Saunders, Director of the Experimental Farm Stations of the Dominion. In the United States of America I am much indebted to the courtesy of Prof. C. V. Riley, State Entomologist, Department of Agriculture, for the large amount of valuable works of his own authorship, and likewise Government publications forwarded to me; and also to Dr. J. A. Lintner and Prof. S. A. Forbes, the State Entomologists of New York State, and of Illinois; to Dr. Hagen, of Cambridge, Mass.; Prof. Comstock, of Cornell University; Prof. George French Normal, Ill.; Mr. J. Marten, of Decatur, Ill.; and Prof. F. M. Webster, of Purdue University, Indiana; and in California to Mr. Matthew Cooke, late Chief Executive Horticultural Officer of California, and to Prof. E. J. Wickson, for information from the College of Agriculture, University of California. To some of the above friends I am indebted for specimens, as well as for correspondence and for publications of great public service, and to all I tender my hearty thanks.

From South Africa I am in receipt of specimens throwing light in some cases on British crop-attacks; also, for personal and collected notes and observations, to Mr. S. D. Bairstow, of Port Elizabeth, late President of the East Province Naturalists' Society, and to Miss Glanville, lady Curator of the Albany Museum, Grahamstown; and am also indebted to Mr. F. von Schade, of Wynberg, for frequent serviceable communication.

In South Australia I am greatly indebted, as I have been for years, to the skilled co-operation and observations of Mr. Frazer S. Crawford, of Adelaide, Inspector under the Vine, &c., Protection Act, and Government Lecturer on Economic Entomology; and likewise beg to acknowledge with thanks co-operation afforded by Mr. A. Molineux, Member of Royal Ag. and Hort. Soc. of South Australia.

Nearer home I have to express my thanks to Senor Don R. Alvarez Sereix, Director of Statistics and Geography, Madrid, for furthering my work with great courtesy; and likewise to Senor Don Ignacio Bolivar, also of Madrid, for presenting me with copies of his valuable writings, mainly on Orthoptera; and I also acknowledge with many thanks the continued communications of Dr. Friedrich A. W. Thomas, of Ohrdruf, near Gotha, Germany, regarding species and history of *Phytopti*. I am under especial obligations to Dr. J. G. de Man, late Curator of the Museum, Leyden, now of Middleburg; and to Dr. J. Ritzema Bos, Professor of Agriculture at the Agricultural College, Wageningen, Netherlands, for the great assistance most courteously afforded me in researches on the *Anguillulidæ*, and valuable works placed in my hands; and similarly to Dr. K. Lindeman, Professor at the Academie Agricole, Moscow, whose researches on the subject of Hessian Fly are well known, my best thanks are offered for writings and for information.

At home, now as ever, my thanks are due to Prof. J. O. Westwood, Life-President of the Royal Entomological Society, for kind assistance, and likewise to Mr. R. H. Meade, of Manningham, near Bradford, especially for their timely and cordial aid on the occasion of the first appearance of Hessian Fly in this country; and I also beg to acknowledge with thanks the assistance given me in comparison of specimens by Mr. Oliver E. Janson, London, and co-operation, in the important field of Economic Entomology, from Mr. S. L. Mosley, of Huddersfield. Amongst many to whom I am indebted, I do not like to omit the name of my sister

and constant helper, Miss Georgiana E. Ormerod, more especially for serviceable aid in translation of German and Spanish works, which other occupations do not allow me time for.

In the above mention of skilled assistance a portion does not bear on the present Report; but I have thought it a duty not only of courtesy, but to those who do me the honour to apply to me, to mention that for information as to such extra-British crop-attacks as it is requisite I should attend to, I am favoured with means of acquiring the requisite information.

To the Agricultural Press I am greatly indebted for prompt and cordial co-operation, and tender my best thanks.

Many of the illustrations in the present Report have not previously appeared; some are drawn from life by myself, and some of the others are figures from Curtis's 'Farm Insects,' for the use of which, as well as of those from the same work which have previously appeared, I offer my acknowledgments to Messrs. Blackie and Son, Glasgow.

In the coming year any information regarding crop-pests, —and especially regarding Hessian Fly,—will be acceptable, including in this information as to its presence, specimens in any stage, information as to "flax-seeds" being found on imported straw, observations of attack at localities to which imported straw has been conveyed as fodder or bedding, or as litter or long manure.

Specimens are also earnestly requested of Tulip-rooted Oat plants, and of Clover suffering from the disease known as "Clover-sickness."

ELEANOR A. ORMEROD.

DUNSTER LODGE, NEAR ISLEWORTH,
March, 1887.

PS. APPENDIX.—As information regarding both Hessian Fly, and Tulip-root in Oat plants, has continued to come in up to date of going to press, the reader is referred to the Appendix for continuation of these subjects; and I also draw attention to an Erratum, p. 47, 9th line from foot of page; for "wormlets *cannot* travel," read "wormlets cannot travel as easily as in light soil."
—E. A. O.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1886.

CABBAGE, &c.

Earwigs. *Forficula borealis*, Leach.

The presence of Earwigs to such an unusual amount as to cause serious injury to some field crops and very widespread annoyance has been reported from various localities respectively in Kent, Buckinghamshire, Bedfordshire, and Wilts.

Prof. Westwood has recorded that these insects sometimes appear in immense profusion, notably in the year 1755, when they destroyed fruit and flowers, and "even cabbages"; and the outburst of the last summer appears to have been a very similar case, as, besides damage to various kinds of plants or crops, including amongst them injury to the leafage of an experimental crop of Tobacco, they were especially reported as injurious to plants of the Cabbage tribe, as Thousand-headed Kale, Kohl Rabi, and Turnips.

As far as I could judge, from specimens sent, the special kind of Earwig present was the *Forficula borealis* of Leach, but very likely the *F. auricularia* was also present.

On Aug. 6th Mr. James Long, of Oldfield, Henlow, Biggleswade, wrote (with specimens accompanying) regarding the damage caused in one of his Turnip and Kohl Rabi fields by the prevalence of Earwigs. He mentions this plague of Earwigs as quite new to him, and one which, whilst it has become of serious and threatening importance, he can in no way account for or alleviate.

"The insects are in great numbers in many parts of the field, and quite destroying many of the plants, especially where the chalk is

near the surface and the land is dryest. . . . The soil has been well treated,—autumn cultivated after wheat, and about 4 cwt. per acre of salt sown on the fallow, beside superphosphate and guano when the seed was drilled. . . . The Earwigs can only be seen by moving the soil around the plants from $\frac{1}{2}$ in. to 8 in. deep."

On the 18th Mr. Long mentioned :—"I have heard from various quarters that on *chalk* formations—*very generally*—the Earwigs have *greatly* injured the Turnip, Mangold, and Kohl Rabi crops." Also that on that day when he went to search for specimens he could not find a single Earwig, even under the plants which were almost destroyed by them, nor under any of the others, although at the previous date of writing there were from six to ten under every plant searched. Mr. Long suggests the possibility "that they have penetrated further into the dry chalk, out of the way of the rain and damp mould, than my searching reached to, although I searched much deeper than I previously found them. I can in no way account either for their appearance or their sudden and complete disappearance from *all* the fields."

On Aug. 10th I was favoured by the following observations from the Hon. Mrs. Cecil Howard as to the prevalence of the same kind of Earwig (*F. borealis*) in the neighbourhood of Great Missenden, Bucks :—

"We are troubled by what I can call by no other name than a plague of Earwigs, and I wish to know whether this has been reported to you, as the whole country round appears to be in the same case. Last week we transplanted some Thousand-headed Kale (planted about six acres), and they did well during the showery weather, and appeared strong. During the last three days these have been completely eaten off, and no fly can be seen, only Earwigs. I do not know if they can have eaten them. The part where the Kale was seeded, and from where it was transplanted, does not appear at present to be attacked."

On application for any details as to method of manuring or other treatment, which might show some reason for the appearance of the Earwigs, the following information was forwarded :—

"This piece of ground, as it lies nearly on the top of one of our hills, has only been manured by sheep (ewes) being penned on it during the winter and early spring, when the weather permitted; they were only fed on roots and mixed corn chiefly grown on the farm, so that would be unlikely to bring insects. This farm is 800 acres, and the men, who have been for the last month Turnip-hoeing and doing those sort of jobs, report Earwigs everywhere, where they disturb the ground. We first noticed them on the silo-rick we made of Clover seeds and Sanfoin: *none* of that ground had been manured, and when the wires that go over the rick were tightened they came out of the

sides of the rick in hundreds. One night the rick-cloth was put over the rick, and some time after it was put up the cloth was *covered*. Also this last week, carrying Peas from the opposite hill, the waggons were *full* of them. The cottagers complain of them, and they simply swarm everywhere round this country."

On Sept. 5th. Mrs. Howard mentioned that they had disappeared from the piece of Thousand-headed Kale, and that it had started growing again; but that they were carried into the rick-yard in great numbers from the adjoining Oat-field.

The extraordinary amount of Earwig-presence was strongly brought forward by the excellently qualified authority, Mr. Martin Sutton, in the following note sent me from Dyson's Wood, Kidmore, near Reading, on Sept. 27th. Mr. Sutton remarked:—"The enclosed cutting from last Saturday's 'Field' exactly describes my own case and those of large numbers of people in our neighbourhood. If possible I think the plague at Dyson's Wood was even worse than that described by the 'Field' correspondent,* and it is only just abating.

"A farmer near here attributes the loss of two sowings of Turnip to the ravages of Earwigs. I do not know how far it is probable they were the cause, but I have had a piece of Mangel Wurzel apparently suffer very greatly from their presence, and roses and flowers of all kinds are riddled through and through with them."

* "A PLAGUE OF EARWIGS.—I occupy a house to which a paddock and large garden is attached; the soil is light, with a subsoil of chalk. Some months ago I was troubled with these disagreeable creatures coming in at the windows and doors, and the only way I could hinder them was by covering all my windows with muslin and closing the doors at sunset. Even then a number managed to wriggle in and cause great annoyance. They dropped on to the supper table, they swarmed in the pantry, getting into fruit pies after cooking, and running out when the pies were out. They pushed their way into the bread, so that we frequently cut slices off these wretches in cutting bread and butter. They found their way into the beds, linings of hats, coats, &c. When the doors were opened in the morning they dropped in such numbers that the mats were literally covered with them. They hide away in the daytime, so there is not much chance of birds devouring them. One evening I amused myself (by the light of a lantern) in killing them on the walls outside, and I hit upwards of eleven hundred with a hammer in about half an hour, and only ceased because I was tired of the game. I could have killed as many more. I then took the lantern and examined a privet hedge about seventy yards in length; this was then in flower, and I found there were as many Earwigs as flowers. This caused me to give up all hope of exterminating them. I had freely sprinkled the window-sills with insect powder, carbolic acid, and paraffin, with no apparent effect. So tenacious are they of life that, when cut in halves, both parts run about for a considerable time. I have noticed several broods during the summer, so that unless the winter destroys them we shall be eaten out next summer. I have not found the lettuces eaten, but roses are perforated and completely spoiled. Last year they were numerous, but this year I believe there were millions."—'Field,' Sept. 25th.

On suggesting to Mr. Sutton the possibility of silos being centres or starting-points for Earwig attack, he favoured me with the following reasons against this being likely :—

“I do not think silos have anything to do with the Earwig plague. There is no silo anywhere near here. I imagine the Earwigs were in the grass before it was put in the silo, just as they were in the corn as it was carted to the ricks at my farm. The beds of the carts and the ground underneath at the sides of the ricks were black with them, and a sample of wheat threshed on the field was full of Earwig bodies, dead and alive.”

The above notes refer (as will have been seen) to presence of the Earwigs in common farm crops, as Turnips, Thousand-headed Kale, Kohl Rabi, Mangolds, and also in Wheat: the following note refers also to damage done to Tobacco grown as a field crop.

About the middle of July communication was sent me by Mr. A. Rayfield, by desire of Mr. Faunce de Laune, of Sharsted Court, near Sittingbourne, relatively to attack of Earwigs on his experimental Tobacco plantation. At first it did not seem quite certain whether the injury was caused by Earwigs or caterpillars, and relatively to this point Mr. Rayfield forwarded the following note on July 16th :—

“I caught a few Earwigs and put them in a bottle, and also some Tobacco leaves on the 14th inst., and find that the Earwigs have eaten some of the leaves; but I believe they have eaten the fleshy part of the stem more than the thin part of the leaf. I notice also that the small leaves of the tops are eaten full of holes in some places, and I have seen Earwigs at night on them, which I believe eat the holes. Earwigs are to be found here this season in swarms, and also in other parishes where I have been.”

Further experiments carried on showed unmistakably that the Earwigs fed on the Tobacco, as the leaves sent, which had been placed with some of the insects in a bottle, were gnawed into good-sized holes. The specimens sent proved to be of the *Forficula borealis*.

It was further mentioned, with regard to the “tremendous swarms of Earwigs, that not only are they eating the Tobacco, but also Turnips and Thousand-headed Kale, and some of the latter have been destroyed by these insects; and one has only to turn over a piece of earth in some fields, and several Earwigs are turned out.”

In the above observations there is no clue to where this enormous invasion of Earwigs came from.

Earwigs lay their eggs in sheltered places, as in manure-heaps, under clods of earth, &c., and it is stated that the female watches her eggs, and even the young after they are hatched, with great care. In the case of the common Earwig, the *Forficula auricularia*, the female lays her eggs early in the year under stones, in holes in the earth, or

the like places ; the young that hatch from these in the spring or early summer are much like their parents in shape, only without wings, and go through their changes like grasshoppers or other insects (which are nearly alike throughout their stages) up to the perfect condition. This perfect insect, in the case of most of the English species of Earwigs, is furnished with a large and beautifully formed pair of wings, elaborately folded under the small, somewhat square-cornered, wing-cases, but, as far as can be gathered, these wings are—with all these kinds but one—not used, or little used, excepting at night.

There are very few species in this country. Of these the *Labidura* or *Forficestila gigantea*, which is about an inch and a quarter long and a very doubtful native, is manifestly outside the present considerations. The *Chelidura*, Latr., is so likewise, being wingless, which clearly distinguishes this kind from the perfect specimens received. *Labia minor*, or the lesser Earwig, which is stated by Stephens to be very abundant in the spring throughout the metropolitan district, and to be found flying about especially in the vicinity of dung-heaps, is the only kind stated to fly in the sunshine, and this is distinguished by various points of structure of the feet and horns from samples sent of the pests of the last summer. The kinds under consideration are therefore limited to the true *Forficulæ*, which it is stated "very rarely fly in this country," and this circumstance, and their objection to exposure to light, appear to be the foundation of all methods for destroying them.

The following note on the subject was sent me by Mr. Ralph Lowe, of Sleaford :—"Small heaps of straw laid at short intervals and fired in a still evening after a few days will destroy immense quantities of Earwigs and beetles. I have seen that plan resorted to rather extensively with marked success in a few exceptionally trying seasons."

A German method of trapping, which is stated to be extremely successful, is to leave old field weed-baskets, made of split willow, standing for a day or so in one place. In the morning to knock these smartly on a smooth clear piece of ground, when such quantities of Earwigs fall out that it is difficult to stamp on them all before they escape. In this case the expedient of shaking the insects out over a tarred board would make much surer work than merely stamping on the escaping insects.

On Aug. 10th Mr. Rayfield wrote to me as follows, regarding the plans then being tried at Sharsted for destroying the Earwigs then injuring the experimental Tobacco mentioned above :—

"We have several plans of catching these insects, but, although we have destroyed a very large quantity, it does not appear to diminish them. The plan that I have found to answer best is by hanging old bags on gates near the Tobacco or on stakes amongst the plants ; old

felt hats also catch a tremendous quantity by placing them on the top of stakes and clearing them out daily."

Possibly where the insects are present in great numbers something to lessen the amount might be done by following up the observation quoted by Prof. Westwood, in proof of some kinds of Earwigs flying at night, "that in a small space of 18 in. square, upon palings fresh coated with pitch on the previous day, no less than fifty or more of these insects had been captured, some of which had still their wings expanded."* Where the insects are ravaging valuable crops in a moderate compass, it might be worth while to try the effect of placing some boards or hanging some narrow long strips of cloth smeared with pitch or wet tar. If successful the expense and trouble would be a lesser evil than loss of the crop.

In garden treatment, and where the dwellers in houses covered with ornamental plants or creepers are troubled with Earwigs, the cure is obvious. If the shelters are removed the Earwigs will commonly be reduced to very small numbers, and (as it is a common habit of Earwigs to lay their eggs under clods of earth, or in holes in the earth, or similar places, and take care of them) all measures of cultivation which would stir the surface well in early spring, and disperse the Earwigs and their eggs, and all measures of tidiness which would clear their various shelters, would be of service.

In regard to the recent field attack, there does not seem any reason for supposing that it was brought on the land in any way, but rather that Earwigs, being unusually plentiful from some reason unknown, they dispersed themselves abroad, and fed on whatever they found suitable for their nourishment.

CLOVER.

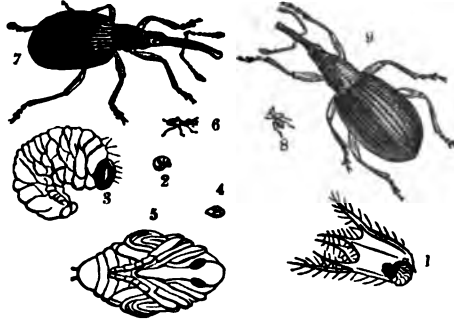
Purple Clover Weevils. *Apion apricans*, Herbst.
(*A. flavifemoratum*, Kirby).

Apions or "Pear-shaped Weevils" are very small beetles with an oval body, to which such a long arched proboscis is prefixed that the whole insect has much the form of a long-stalked pear, whence its name.

There are many species, some of which do great injury to Clover: the two kinds figured are common on the Red or Purple Field Clover, *Trifolium pratense*. To the naked eye both kinds are of a metallic-black, with the lowest joint of the horns, all the thighs, and

* 'Introd. to Classification of Insects,' vol. i., p. 408.

the shanks of the front pair of legs of a yellowish colour, or some shade of brown or reddish. In the *A. apricans* (*subfemoratum*, Kirby) these portions are described by Curtis as lighter or yellower than in



APION APRICANS, Herbst. ; A. ASSIMILE, Kirby.

6, 7, *A. apricans* ; 2—5, maggot and pupa ; 8, 9, *A. assimile* (all nat. size and magnified) ; 1, maggot feeding, magnified.

the other species, and there are other differences, but these are so slight that at one time the two kinds were considered to be mere varieties.

There is a third kind (the *A. trifolii*), which is very like the above both in shape and colour, which is said to occur sometimes in large numbers on Purple Clover. The *Apion apricans*, more especially known as the Purple Clover Weevil, may be generally described as follows :—Black ; proboscis curved and punctured. Horns black, with base of a brownish yellow, and placed at the middle of the proboscis. The thorax or fore body cylindrical, smaller before, and punctured. Head punctured, channelled between the eyes. Wing-cases with deep furrows, the spaces between convex and slightly punctured ; the furrow punctured at regular distances. Legs black, with yellowish or reddish thighs, and the fore shanks chiefly of the same colour.

The three kinds, however, above mentioned cannot be distinguished from each other without the help of a good magnifier, and, as far as I am aware, their habits and life-histories are considered to be alike.

After careful examination, especially of the minute leg-joint, scientifically called the *trochanter*, I incline to think that there were very likely both *A. apricans* and *A. trifolii* present in the specimens sent me from Somersetshire.

In the beginning of September heads of Purple Clover infested by "Clover Weevil" were forwarded to me by Mr. Burch from Girelston, West Buckland, Somerset, where the maggots were then doing much harm to seeding Clover. About fifty acres (which were being saved for seed) had then been observed to be

infested by small white maggots, which were feeding at the base of the florets, and it was stated that every field of Clover in that neighbourhood "was similarly attacked." Enquiry was sent whether the maggots would destroy the seed, with the view in such case of cutting the crop for hay instead of leaving the seed to ripen.

At the same date Mr. Broadmead, of Enmore Park, Bridgwater, reported a similar attack on Clover seed in that neighbourhood. "In each head are small white maggots, generally five or six in number. Whole crops have been destroyed, and I have found scarcely a single plant unattacked." The loss is, of course, very great.

On examination I found *Apion* maggots in the Clover-heads sent. These are little fleshy white maggots with brown heads, of the shape figured at fig. 8. The grub lies somewhat curved together and is legless, the front segments enlarged below, and tubercled so as to aid in such amount of progression as it needs to make.

The life-history of the Purple Clover Weevil is as follows:—The beetles live through the winter, and when the Clover has run up to blossom the females lay their eggs in the flowering heads. The maggots which hatch from these eggs make their way through the calyx to the forming seed, on which they feed. They are stated to make their way into the seed, and feed on it until it is consumed; then to make their way out and to turn to chrysalids amongst the drying flowers. In the specimens sent me I found some of the little maggots free in the heads. From these chrysalids the weevils come out in about a fortnight, or, in the case of autumn broods, *may remain in chrysalis-state till spring*. This point may be important for practical purposes, as also that mentioned by John Curtis of the weevils being soft and tender when first developed from the chrysalis-state, which I had an opportunity of observing in the specimens sent. As the stages of their life-history are gone through rapidly there may be several generations in one year; the pests stored as maggots or chrysalids with the first harvested Clover will produce swarms of weevils to come out and attack the blossoms of the second crop, and so continue their generations, weather and crop permitting.

Besides the loss caused by the weevil-maggots destroying the seed in the head, the weevils themselves do harm by feeding on leaves of the growing Clover.

With regard to possibility of applying any remedy to attack when present in the flowering heads, it does not appear that when the flowers present the rusty or prematurely withered appearance, which shows that the maggots are feeding on the forming seed, that any measures to save it can be of the slightest service. The crop need not be totally lost, for it can be mown under common circumstances for hay.

The only thing which it seems possible to do is to lessen the amount of weevil-presence in the neighbourhood beforehand, and, as the points of this treatment have been so well given many years ago by M. Herpin that it is hardly possible to state them more clearly, I quote them from the translation in Curtis's 'Farm Insects':—

"1st. Cut early, and feed off (while green) the Clover crops which are known, or supposed to be, much infested by the *Apion*.

"2nd. Carefully avoid allowing the Clover crops to remain more than two years in succession on the same ground.

"3rd. Avoid also allowing the Clover which is much infested by the weevil to ripen and run to seed.

"4th. Alternate and vary the culture."

The 5th suggestion is that, if the Clover is stacked green, and subjected to a sufficiently high fermentation to turn it brown, that the maggots contained in it will be destroyed. At the present day the use of the silo would assist in this case.

Where infested Clover is stacked in the common manner great numbers of weevils escape from it, and very probably something might be done to kill these by throwing quicklime or gas-lime on them. When they are in such numbers (as has been recorded) that there are scores on one plant, and they are regularly sweeping on from the stack from which they started, something might be done to get rid of these hordes. When properly developed the Purple Clover Weevil has a powerful pair of wings, but in those which I examined, which developed in captivity in a closed box filled with Clover-heads, so that there were no favourable circumstances for expansion, most of the wings were abortive, or not properly formed. Where this is brought about in farm practice by the above mentioned methods of stacking or otherwise, it would be a great check on spread of the pest.

The habits of the two kinds of Red Clover weevils are considered to be similar.

The measures suggested by Mr. Whitehead of feeding off infested plants in autumn by folding sheep on the leys, and likewise of burning refuse Clover-heads after threshing, could not fail to be of service.

CORN.

Hessian Fly; American Wheat Midge. *Cecidomyia destructor*, Say.



Hessian Fly, natural size and magnified.*

As far as at present appears there has been no recorded presence of the Hessian Fly in Britain until the latter end of July of the present year (1886).

Those who desire to trace its history from its first outburst as a destructive scourge in North America during the years 1786 to 1789, with full reports of its history, habits, gradual spread, destructive powers, and ravages, up to complete attacks of crops, onwards to the date of its first proved appearance in Europe, and the testimony borne (up to July of the present year) of the absence of this pest from our own country, will find information on these subjects in the works whose titles are quoted in the appended table.

Relatively to the watch instituted on its very first appearance in America lest this pest should be transmitted to our own land, we find that in 1788 the wheat crop was so much injured in various North American localities, from which corn was then exported in large quantities to Great Britain, that the exportation of grain from America was prohibited until the English Government was assured that the fly with eggs could not be introduced in the grain;† and next, that consequently on the annually recurring tidings of the more and more widely extending devastations of the Hessian Fly in America, the investigations on this side the Atlantic were set on foot by Sir Joseph Banks, the result of which was, as reported by him, "that no such insect could be found by him to exist in Germany or any other part of Europe."‡

* The following paper is a reprint of my pamphlet, 'The Hessian Fly in Britain,' giving an account of the main points of the observations up to the date of going to press. Further information will be given, if desirable, in an appendix.

† Bulletin No. 4 of U. S. Entomological Commission.

‡ Dr. B. Wagner on Hessian Fly. Report of U. S. Entomological Commission, 1880-82; Appendix I., p. 28.

An alarm took place as to the arrival of the pest about the beginning of the present century, which was proved to be unfounded by evidence that it was another kind of fly.* The well-known passages in Kirby and Spence's 'Entomology' as to the destructive character of this pest *if* it gained footing give a long range onwards of *non-observation* from about 1815 to the date of the edition of 1855; and in 1845 John Curtis notices the attack as one which, as it had *then* been detected in Europe, it was well to mention. And, in the summary of information given in the 'Report on Hessian Fly,' brought out by the United States Entomological Commission, 1880-82, I find these statements: "We know that the *Cecidomyia destructor* does not inhabit England or Scandinavia."†

Throughout this course of years we do not find any authentic notice of the Hessian Fly occurring on our side the Atlantic until possibly 1833 in Hungary, but the first sure statement of the existence of the Hessian Fly in Europe is considered to be that of "its discovery, by Mr. J. Dana in 1834, at Mahon, Toulon, and Naples" ("Hessian Fly not imported from Europe," 'Canadian Entomologist,' 1880).

It is now known to exist in the South of France, Austria, Hungary, and during the last seven years its presence has been reported in Southern Russia, and its original habitat is considered most probably to have been Southern Europe and Western Asia, *i. e.*, about the shores of the Mediterranean Sea. (Report of U. S. A. Commission, previously cited).

The past summer has shown its presence amongst ourselves. On July 27th the first specimens of the peculiar flax-seed-like pupa were forwarded to me by Mr. G. E. Palmer from his barley fields near Hertford, and shortly after the attack was reported as found on other neighbouring farms. On Aug. 10th some small amount was found at Stubbess, near Romford, Essex, in wheat; on Aug. 28th the same attack, with pupæ now advanced to the striated condition (that is,

* See Linn. Trans., ii., 76 - 80.

† The name of Hessian Fly was originally given in consequence of the fly being noticed about the same time with the arrival of the Hessian troops in America. Those who wish to see the evidence by which this transmission is thoroughly disproved will find the subject entered on at length in a paper by Dr. Hagen, entitled, "The Hessian Fly not imported from Europe," 'Canadian Entomologist,' October, 1880. The dates, with names of ports of embarkation and those of arrival in America, are there given both of the Hessian and German troops; and (to give just one note of the various movements specified) it will appear plain that where troops left Hesse in February, Spithead in May, and arrived in Sandy Hook in July, or up to August 12th, that the "flax-seeds" could not by possibility be thus conveyed. If pupæ had been in the straw (if straw was conveyed) they would have developed long before the middle of summer, if they were in a state to develop at all. Full details will be found in the paper referred to.

with lines running lengthwise along them), was found at Ware; and on Sept. 1st and 2nd respectively similar attack was reported (with specimens accompanying) from barley near Inverness, and also from barley near Crieff, Perthshire. In all cases the nature of the attack was identified by sample specimens forwarded to me. Reports were also sent me of similarly injured straw being observed in various parts of Scotland, and that "the insect had been observed in various counties widely apart."

On Sept. 22nd Mr. G. E. Palmer reported that the pupæ of the Hessian Fly had been found at three farms near Hertford, two farms near Hitchin, one near Ware, and one near Luton, Bedfordshire. These localities include Mr. Palmer's farm and that at Ware previously mentioned. The observations were taken by Mr. Palmer and Mr. H. Dorrington, residents near Hertford, perfectly qualified to identify the attack.

Amount of injury caused by Hessian Fly attack.

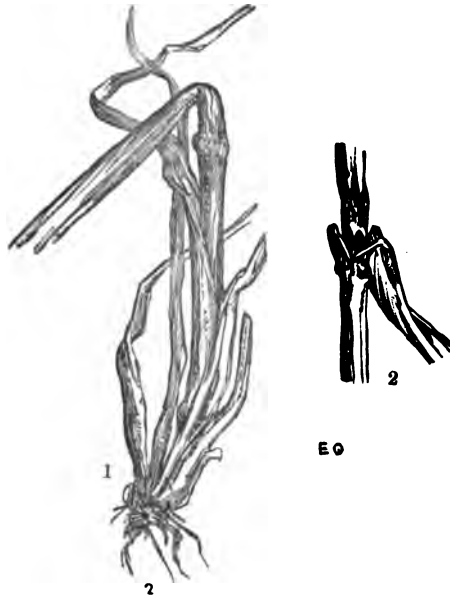
It is unnecessary here to enter on the losses liable to be caused by this attack, of which details will be found in the works referred to in table appended. They may be shortly stated as any amount from slight attack up to devastation of whole large districts. Some of the communications regarding amount of attack this year in this country mention "the barley being very much injured" (this on fields respectively of 88 and 15 acres); "considerable damage"; being "struck with the number of broken-down stalks"; and one estimate is of a "loss of several bushels per acre" (this from one English and three Scottish localities); and a general report sent to myself mentioned the attack in Scotland as having "been observed in various counties widely apart, and causing considerable havoc to crops and anxiety to farmers." Just as an example of amount of loss in the United States, in one State, at dates widely apart, it may be mentioned:—In New York State the loss last year through this attack was estimated at 100,000 dols.; in 1846 the insect was destructive through the whole State, and the loss in the western section was estimated at 500,000 bushels. Details of losses in various years and localities in U. S. A. from 1776 will be found in the Report of the U. S. A. Ent. Commission, previously quoted.

Appearance of attacked Crops.

In Mr. Palmer's notes of the appearance of his infested fields, he mentioned that at first he thought that the barley was "simply root-fallen," but on closely examining the stems he found that most of them had given way just above the second joint from the root, and

then found that the maggot, of which the chrysalis was sent, was the cause of the attack; and in the report of the attack from near Perth there is similar mention of the broken-down stalks and small brown pupæ found at the injured part.

On examination in the fields near Hertford, on the 80th of July, I found the stems doubled sharply down a little above the joint, as shown in fig. 1, No. 1, and between this double and the joint below there lay, closely pressed to the stem and covered by the sheathing-leaf, the flax-seed-like chrysalis-cases, figured on the right hand of the bent stem. The injury is caused by the fly-maggots lying at the same spot sucking the juices from the stem, which is thus weakened, and

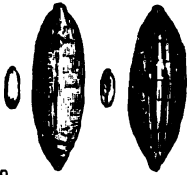


No. 1.—Attacked Barley-stem; 1, bent down; 2, showing "flax-seeds."

presently, although both the stem and the ear above are more or less stunted, yet the weakened piece of stem cannot bear their weight, and it bends sharply down at the injured part. Sometimes a gall or some amount of swelling of the stem occurs just above where the maggot fed, but in the specimens I examined this was rarely noticeable. I am told by Mr. John Marten, of Albion, Illinois, U. S. A., an economic entomologist who has especially made a study of this attack, that the specimens I showed him corresponded in absence of gall with the condition of those in Illinois.

"Flax-seeds," Chrysalis-cases, or Puparia.

These were from one up to sometimes three or four in number, usually only one or two; they were invariably set upright (not lengthwise across the stem), and sometimes, but not always, were fixed at the lower end by being a little embedded in the straw. The "flax-seeds" were for the most part the sixth of an inch long, of a spindle or long oval shape, somewhat slightly flattened on one side, and more so on the other; the two extremities bluntly pointed, one conical, the other, which is the anterior end, usually slightly bent forward with a pinch across the "flax-seed" near the end, as if the flattened side had been bent in almost against the other side by a nail. The colour was



E O
No.2.—"Flax-seeds"
or Puparia, in different
stages of development,
nat. size and mag.

at first of various shades of chestnut, from quite light to full brown, and both in colour and in shape the cases had a strong resemblance to the flax-seeds from which they take their name, except in being narrower. This brown case is the hardened skin of the maggot, and in this *puparium*, or pupa-case, the maggot changes first to the *pupa* and thence to the perfect fly; at the earliest part of the observation the transverse lines showing the divisions of the segments of the maggot were still noticeable, but gradually, as the skin hardened, it contracted lengthwise, and the transverse lines wholly or almost entirely disappeared, and instead of these the flax-seed was marked with parallel lines. The first specimen in which I noticed these running along it from one end to the other was sent me from Ware on the 28th of August. The figure is taken from two of my own specimens in different stages of development at the beginning of October.

P.17F

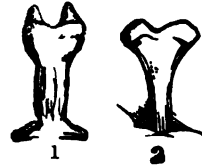
Contents of the "Flax-seed," Chrysalis-case, or Puparium.

As the attack had passed into the flax-seed state before it was reported, I had no opportunity of observing the maggot whilst it was still active and in feeding condition; therefore, in order to keep the British observations clearly distinct from those of other countries, the description and figure of the maggot taken from Dr. Packard's paper on the Hessian Fly is appended in a note.* I had, however, the opportunity, by careful dissection of a newly-formed "flax-seed," of making out some of the points of the structure of the larva. On opening the brown case I found the legless maggot within still unchanged as to development; it was bluntly oval, with the head

* "The egg is very minute, about the fiftieth of an inch long, cylindrical, pointed at each end, the shell shining and transparent, the egg being of a pale red colour when the embryo is nearly developed.

retracted, and it was of a white milky colour, excepting at the divisions of the segments, and also along the central line from one extremity to the other, which were all of a greyer tint. This appearance is stated by Dr. Wagner to be the beginning of the development of the adipose body, which "is distinguishable as snow-white masses from the remainder of the more transparent body."* Beneath the maggot, close to the head-end, was the chitinous appendage, which is known in America as the "breast-bone" of Cecidomyiaceous larvæ, with us the "anchor-process."

As I am not aware that this anchor-process of the larva of the *Cecidomyia destructor* has as yet been precisely figured, I give a magnified sketch from my own British specimens. The anchor-process is a short stem fixed at one end to the larva, and free at the other; the free end, which points forward, is considerably enlarged, and is of various form. In the "red maggot" of our own British Wheat Midge it is notched, as at fig. 2, No. 4, but in the anchor-process of the Hessian Fly the shape is more elaborate. The stem is slightly enlarged at the middle, and the extremity furnished with two conical prolongations, forming together a strong fork. When seen sideways the process looks more slender, and has a curved figure making a gentle arch from the insertion to the forked tip.



No. 4.—1, anchor-process of larva of *C. destructor*; 2, of *C. tritici* (magnified).

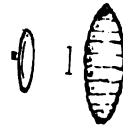
The use of this appendage does not appear as yet to be fully known, but from my own observations I conjecture that it is used as a digger or scraper, and it may be that the reason why strong-stemmed wheat, or stems containing more silica, are not so much injured by attack as other kinds, is, that the fork is not strong enough in these instances to assist the excessively delicate mouth-parts to acquire their food from the stem.

The formation of the skin of the maggot is very peculiar, and, as

"*The larva.*—After remaining about four days in the egg-state the larva or maggot of the Hessian Fly hatches, and is of the form represented. The body is soft, smooth, shining, oval, cylindrical, beneath a little flattened, and consists of twelve segments besides the head, the latter soft, fleshy, and but little separated from the body, with very rudimentary mouth-parts."—Hessian Fly Report of Department of Agriculture, 1890-82, p. 208, previously cited.

The above figures of egg and larva are copied from the same. The larva, when fairly advanced in growth, is stated by Dr. Wagner to be white or yellowish white, transparent at the sides.

* Dr. Wagner on the Hessian Fly, Appendix I. Third Report of United States Entomological Commission, 1880.



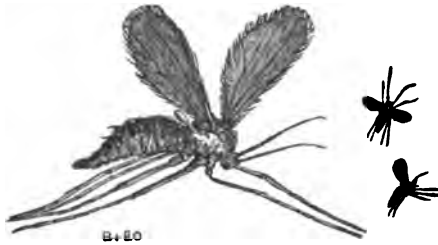
R + P
No. 8.—Egg and maggot of Hessian Fly, nat. size and mag.

seen under a $\frac{1}{4}$ -inch power, resembles nothing so much as a nutmeg-grater. It is covered with most minute tubercles, each about the height of its own width, and each with a depression or orifice in centre. The two figs. at No. 5 give a view side-ways and from above of these tubercles from the dried skin of a larva, with the anchor-process attached, taken from the puparium.



No. 5.—Skin
of larva,
magnified.

About the beginning of October, on again examining the contents of a "flax-seed," I found the larva or maggot within considerably altered. It did not as yet, as far as I saw, show any development of limbs, but it was now changed to a reddish yellow colour, of a brighter red along the back. As these changes of tint are stated by Dr. Wagner to follow almost immediately on the rudiments of the coming wings being observable, it is probable that examination with a better light, or with a stronger microscope-power, would have shown their appearance.



No. 6.—*CECIDOMYIA DESTRUCTOR*, Say. Hessian Fly, nat. size and magnified.*

The Imago or perfect Fly.

On the 8th of September the first fly developed from my "flax-seeds" or puparia. This to the naked eye was a stout-made little brown gnat, with darker head and body, legs of rather lighter brown, brown horns, and a pair of smoky-grey wings with longitudinal veins. It was exactly one-eighth of an inch in length.

In order to note the successive changes in colour occurring up to maturity and immediately after death, I observed the specimen at intervals for about three days, and endeavour to give the result as plainly as I can. The fly was first noticed about four in the afternoon amongst my specimens of infested straw, and I secured it by passing a long fine rod of twisted paper just moistened at the tip with chloroform beneath it; this stupefied but did not quite kill it, so that I could observe it with very slight disturbance from movements of the insect.

* The position of the imago is after the fig. *f.* by Mr. Burgess in plate iv. of paper on Hessian Fly in Third Report of U. S. A. Ent. Comm. already quoted; the details, &c., from my own British specimen.

About three hours after being first noticed the abdomen, as seen with a 1-inch power, was of various tints of a yellow-brown colour.* The following morning, on investigation of details, the thorax was black above, yellow or pale yellowish brown beneath the root of the wing, and with another patch of the same colour in front,—that is to say, a patch about half-way down on each side of the prothorax. The six segments of the abdomen nearest the thorax of a raspberry colour, paler below, with a broad black transverse band extending over the back and half-way down the side of each segment, which was also marked with a well-defined black velvety patch on each side. The terminal segments of the abdomen and the extended ovipositor were of nearly the same shade of yellow, or pale yellowish brown, as the patches on the side of the fore body, and the ovipositor was *not* furnished with lamellulæ at the extremity. The 7th and part of the 8th segments were marked above with a small V-shaped figure with a fine line on each side, parallel to the sides of the V, the lowest end of the V pointing backwards. The figure was only noticeable when the abdomen was seen from above, and was not of deep tint.

The halteres or poisers were of a bluntly-pointed club-shape at the extremity, and yellow with a sprinkling of hairs, which in some lights gave a blackish tint to the upper part and also to the base of the club, and at this stage there was a marking of raspberry-red just about the middle of the poisers. The body and abdomen were in parts very hairy, and the black velvety patches on the sides of the abdomen appeared to be composed of stout, black, bristle-like hairs. The two wings smoky-grey, fringed at the edges with long fine hairs, and sprinkled over the surface with hairs, and also with ribbed scales, resembling one of the forms found on butterflies' wings. The wing-veins all ran lengthwise, the first almost close to the front margin of the wing, running parallel to it, and uniting with it about half-way down; the second running straight along the wing at rather less than one-third of the whole width of the wing from the front, until near its termination at the tip of the wing it curved slightly backwards; the third vein (placed about the width above mentioned from the hinder margin) runs almost straight, ending at the hinder margin about one-quarter of the length of the wing from its tip; this third vein throws out a side-branch, which curves backwards to the hinder margin of the wing exactly opposite the termination of the first vein. Legs very long and fine, yellowish brown, hairy; uppermost joint of tarsi very short. Eyes black; antennæ beaded, long, and hairy. The two basal joints shorter and wider than the succeeding beads. The

* For fuller descriptions than I can give from my own observations of the early changes of colour the reader is referred to Dr. Wagner's paper, previously referred to.

remainder of these up to the apical joint (with the exception of those immediately succeeding the basal joints)* were rather longer than wide, apparently cylindrical in form, and slightly contracted at the middle; the terminal joint was bluntly pointed and about as long again as the preceding bead. These joints were at first distinctly stalked, so that, excepting towards the end of the antenna, they could be seen to be distinctly separated. From the minuteness of the division, and also as with maturity and death, the beads drew so nearly together as almost to appear to touch, I had great difficulty in counting them, but after repeated examination they appeared to me to be nineteen in number, that is, 2 plus 17. The colour altered with change of condition of the specimen, but might throughout be called brown.



No. 7. Wing
of Hessian
Fly, mag.

The above account refers to the condition of the specimen whilst still not quite dead, about eighteen hours after the first observation. Twenty-four hours later the raspberry tints were changing to shades of brown or yellowish brown, and the black velvety patches at the sides of the abdomen were scarcely distinguishable from the transverse bands. The changes in colour continued, till on the third day from the first observation the raspberry tints had changed to dark brown above, lighter or yellowish brown below, the terminal segments and the ovipositor still retaining the original tint of yellowish brown.

From minute examination of structure and comparison with the descriptions and figures in the works cited, the imago appeared to me to be without doubt the *Cecidomyia destructor* of Say, commonly known as the "Hessian Fly."

In an attack of this importance, regarding which it is yet to be seen whether it will settle in the land as a national scourge, or be a temporary infliction from causes not yet made out, I in no way desired to rest solely on my own opinion. I therefore submitted infested straw to Professor Westwood, Life-President of the Royal Entomological Society, who is personally acquainted with the insect in the "flax-seed" as well as in the perfect state, and also forwarded others to Prof. W. Saunders, President of the Entomological Society of Ontario, Canada, a well-known and most sound authority in the matter, and received from both the above referees the confirmation that the specimens sent were without doubt the pupæ of the true Hessian Fly. On the appearance of the imago I submitted it for special examination to Mr. R. H. Meade, of Manningham, Bradford,

* I unfortunately omitted to make a note of the precise form of these at the time; from memory I should say they were like the corresponding joints of the male antennæ, as figured by Dr. Packard, but not having figured and noted them at the time the observation may not be correct.

whose researches on the Diptera are too well known to require any comment, and had from him the benefit of definite opinion that it was *Cecidomyia destructor*, Say. Further, I have had the opportunity of submitting the whole series of specimens to Mr. John Marten, of Albion, Illinois, U.S.A., one of the economic entomologists of Illinois, known by his papers on injurious insects, published in Reports of the Department of Agriculture, U.S.A., and whose opinion is of much value, as having made a special study of the Hessian Fly.

Abstract of Life-history.

The following extract from a German source* gives the main points of the life-history of the fly in Europe in short and plain form :—

"*Cecidomyia destructor*, Say.—The larvæ live in the haulm of wheat, rye, and barley. The female flies usually lay their eggs on the young leaves twice in the year,—in May and September,—out of which eggs the maggots hatch in fourteen days. These work themselves in between the leaf-sheath and the stem, and fix themselves near the three lowest joints, often near the root, and suck the juices of the stem, so that later on the ear, which only produces small or few grains, falls down at a sharp angle. Six or eight maggots may be found together, which turn to pupæ in spring or about the end of July, from which the flies develop in ten days."—Stett. Ent. Zeit., xxi., p. 820.

Where does Hessian Fly come from ?

The question now arises, Where does the attack of Hessian Fly come from? It does not appear to have risen up gradually in the country, as we find it widely spread,—that is, in various parts of Scotland, as well as in one district of England,—without any observation of its previous presence having been reported from any quarter, although the attack is of a kind which is very observable, and attention is given to insect injuries to the crops more or less in every part of the island. It may come in the "flax-seed" state in straw imported from any of the countries troubled by this pest; it may be received from Canada, or from the United States, or from the South of Europe, Austria, Hungary, or Russia.

In respect to its importation in straw, it may come in straw-cargoes, or in straw used as packing material. Where this straw is sent forward to farms as it is, or as slightly-used litter, or as "long" manure, quite a sufficiently large proportion of the flies in the flax-seeds are likely to develop to cause mischief such as we have seen in

* See Die Pflanzen feinde, von J. H. Kaltenbach. Stuttgart.

the past season. On the first farm on which the attack was observed near Hertford, I found on enquiry that London manure had been used of mixed kind, but mainly cow and horse manure in "very long" condition.

Another way in which it is at least possible that the "flax-seeds" may be transmitted is in wheat or barley from infested countries. This method of transmission is stated not to be at all likely, because the sheathing-leaf enfolds the wheat or barley stem so tightly just above the joint where the pupæ lie that it is considered they would not fall out in the process of threshing. But on investigation of the attacked straw, both in the field and after being stored away, I found it very liable to break at the bend, and thus expose the contained "flax-seeds"; and on October 22nd I received information from Mr. Palmer, of Revell's Hall, that after threshing some of his infested barley he examined the small seeds and dust sifted out of the threshed corn which fell beneath the machine, and in this he found "flax-seeds" to the amount of fifteen in a handful of siftings. Specimens of these were forwarded to me.*

No pupæ were found in chaff or grain. This matter will be further investigated by observations from other farms, and all information is solicited on the point, as it is of enormous importance.

In cleaning seeds of the fox-tail grass from those infested by *Cecidomyia* of another species, it is found the infested seed, being lightest, falls at a separate spot; and, if we find that the Hessian Fly puparia fall just below the machine customarily, there will be neither difficulty nor loss in collecting the rubbish and dirt and destroying it.

From the above observation it appears that puparia or "flax-seeds" may be transmitted in corn rubbish. In samples of screenings and "sweepings" from imported corn I have found, besides a large amount of live and dead beetles, also weed-seeds, ergot, and other matters undesirable to spread abroad (as may easily be done where these are used for poultry-food, and thus thrown out in farmyards), and as, with these, broken bits of stem are to be found, it appears at least possible that "flax-seed" may also be conveyed. In Dr. Packard's paper on the subject (previously quoted) he alludes to the possibility of the pest being transmitted in wheat.

Methods of Prevention.

At present nearly all we know on this head is learnt from agricultural publications of other countries, and especially from the Reports of the Agricultural Department of the United States, but in our own country we have one regular and constant safeguard against

* The observation has since been further confirmed.—E. A. O.

autumn attack in the fact that wheat in this country is not sown usually until well after the time when plants may be considered safe from eggs being laid upon them by the autumn brood of the Hessian Fly.

This point of prevention is stated as follows in the Third Report of the United States Entomological Commission: "*Late sowing of most of the wheat seed.* All writers, both entomological and agricultural, concur in recommending this easily applied remedy, that at least a part of the wheat should not be sown until after the 20th September in the Northern States."*

In this country this remedy is applied for the most part in regular process of farming arrangements; commonly our wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

The Hessian Fly has commonly two broods in the course of the year. The flies which come out in August or September from the "flax-seed" chrysalis-cases, sheltered above the second joint of the straw from the ground (such as we have this year been troubled with in England and Scotland), lay their eggs, we are informed by various observers, Professor Riley, State Entomologist, U.S.A., amongst the number, in the grooves on the surface of the leaves, or between the stalk and sheath where loose, and, as soon as the footless larva or maggot hatches, it makes its way down the leaf to the base of the sheath, which in the young winter wheat is at the crown of the root. Here it is stated to fasten itself lengthwise to the tender stalk, and to move no more, but remain fixed at one spot sucking the juices until it becomes embedded at one extremity in the outer part of the stalk, and in five or six weeks, according to the season, to turn to the flax-seed chrysalis. In the case of attack to the young wheat, the maggots drawing away the juices just near the ground-level, cause it to turn yellow and die.

The flies from these "flax-seeds" come out in spring, or about the beginning of May, and, as where the corn is running up to stem the tender ground leaves are no longer to be found, which are used for autumn egg-laying, the flies have no choice, but they lay them instead, as we know, so that the maggot when hatched shelters itself between the stem and sheath just above the first or second joint from the ground, and there it turns to the flax-seed chrysalis, from which the autumn brood presently come out.

To return to autumn means of prevention, as previously said, if there is no accommodation ready for the autumn brood, a great deal of it necessarily perishes without egg-laying, but further (in case quite

* See Third Report of United States Entomological Commission, Department of Agriculture, p. 221, 1880 - 82,

early-sown wheat is found to be infested), by *ploughing this in* the maggots and eggs will be killed; and, in the words of Dr. Packard, this brood may be circumvented or destroyed so that a spring brood cannot appear from it.

A less expensive method of attracting the flies is the use of what is called "bait," that is, sowing some narrow strips of wheat to attract the flies, *and ploughing this in with the eggs and maggots*; but for ourselves the plan arranged by Mr. G. Palmer on his farm of Revell's Hall, near Hertford, appears best of all as costing little or nothing, and meeting all purposes.

Mr. Palmer showed me that on his worst infested barley field, which was bare at the root, he had allowed all the self-sown barley to sprout; thus it was ready for attack of all the flies which were hatching, or might be hatching, out of the "flax-seeds."* When the time was passed the plant was to be fed off by sheep, which would eat the leaves with eggs on them, and any maggots which had effected a lodgment in the centre of a plant too far down to be bitten out would be effectually killed by the subsequent ploughing coming in regular course of operations.

The above refers to where stubbles are left; where they have been cut high so as to leave the infested part standing on the field it is probably the best plan at once to skim and collect the stubble and burn it, but from the practical difficulties in the way of carrying out this high cutting, and the amount of loss entailed, it does not seem likely to be carried out.

Deep ploughing directly after cutting of stubbles which have been infested would turn any "flax-seeds" which had been shaken out well under, so that the flies from them, even if they did hatch out, could not make their way to the top. Where there is clover or seeds it does not seem possible to do anything relatively to attack that may very likely recur on the self-sown corn, excepting what may be done to kill the young maggots or "flax-seeds" by dressings; for this purpose the use of lime, salt, or soot have been recommended.

In regard to infested straw taken off the field, I am informed by Mr. John Marten (quoted previously) that it is found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow; thus a very great proportion of the flies which come out of the "flax-seeds" are

* Nov. 1st, 1886. During the last few days specimens have been sent from these plants, and shoots from old plants infested with Hessian Fly puparia in various stages, from white condition just passing from larval state up to regular "flax-seed." This shows that the *puparia* found in the corn-stems in August, or a portion of them, do hatch out their flies in this country, and *confirms the need of every precaution*.—E. A. O.

destroyed, simply because they are not able to get to the outside of the stack.

It is difficult to see how, except on a broad scale, by arrangement like the above we can manage to meet the difficulty of attack spreading from infested straw. In any common way in which it is used it is open to letting the fly escape from it, and it is impossible without very severe loss to destroy it. The method of saving the straw which places the greater amount of it in a condition in which it cannot spread attack, whilst being stored for gradual use, seems worth consideration.

With regard to chaff and rubbish from the threshing, we do not as yet know what amount of "flax-seed" is to be found in them, and we need report from competent inspection, so that we may know with certainty what amount of "flax-seeds" are to be found in them. It will be eminently desirable that infested chaff should be mixed with wet manure, or destroyed as may be most convenient as rapidly as possible.

One of the most important remedies or means of prevention of damage is hearty growth, which will carry the young plant through moderate attack, or, if part perishes, will carry the other shoots on; and another is the choice of hard-stemmed wheat.

The evidence now coming in points to the possibility of the "flax-seeds" being loosened, and more observations will shortly be sent in; but meanwhile (see p. 20) it is of the utmost importance, in threshing infested crops, that the siftings taken from immediately below the machine should be burnt.

Dressings, &c.

Lime, soot, salt, and "plaster" are mentioned as being serviceable as dustings on young plants infested by maggots. By plaster I am informed burnt gypsum or plaster of Paris is intended. There appear to be various opinions as to real benefit from these applications, and also whether they can, even when melted by rain, reach the maggot sufficiently to destroy it; but, in case of any dressing being useful, it seems likely that the mixture found serviceable many years ago by Mr. Fisher Hobbs might answer still better, as in this the gas-lime would take the place of the gypsum or plaster. The mixture consists of quicklime and gas-lime, each one bushel; soot, ten pounds; sulphur, six pounds; the whole to be well powdered and mixed and applied when the dew is on. The above amount was sufficient for dressing two acres of Turnips as a preventive for fly, and the quantity could be increased at discretion. This application would in any case be useful by promoting good growth, which is a point very much dwelt on as a preventive of overwhelming damage from attack; in illustration

of this point a note is given in Dr. Packard's paper, previously quoted, regarding attack to a field of young wheat. In the hollows on deep soil "the wheat was very large, and kept green and growing; while on the sharp points of knolls and hard clay ridges it was nearly gone. On a piece of new land near by, where never a kernel of grain was grown before, no fly or injury could be seen." The first part of the above observation agrees very much with what I saw on the attacked land at Revell's Hall. One large field of about thirty acres at the top of the hill, and another adjoining, which were on dry shingly soil and greatly exposed, were much the worst attacked; whilst another in the hollow, which was cooler and better land altogether, had not suffered nearly so much. Should we have the misfortune of this attack settling down amongst us it will be worth observation to find whether the fly comes worst to the crops sown alone or with clover or seeds. In the fields above mentioned the worst attacked were barley alone; the least attacked had clover and seeds.

Rotation of crop, which excludes wheat, barley or rye on attacked land, is exceedingly important; the Hessian Fly only attacks some of the cereals, therefore all leguminous and root-crops are perfectly safe, and likewise, as they cannot be used as food, help greatly in lessening the prevalence of the pest.

The choice of kinds of corn with hard stems, such as cannot be easily injured by the suction of the maggot, is also particularly dwelt on and kinds named, but as these differ from our English kinds it is unnecessary to give the list. A summary of the above might be shortly stated thus, beginning at harvest-time* :—

If possible reap so as to leave the "flax-seeds" in the stubble, and destroy this infested stubble; otherwise treat the harvested straw so as to destroy them.

If flies are likely to be about let the self-sown corn on fields that were infested sprout, and presently turn sheep on to feed off the infested plants, and then plough the remains in. Ploughing in infested stubble is also useful. "Bait" may also be had recourse to by sowing strips or patches of corn to attract the fly, and treating them as above.

Late sowing, so that the young wheat will not be up until the

* In American treatment the great importance of preserving the insect parasites, which feed on the Hessian Fly in its early stages, is most urgently insisted on, as in that country they are as much looked to for keeping down the attack as Lady-birds are in our own as a check on Hop Aphid. Consequently burning stubbles, or burying them deeply, or other treatment which would kill parasites as well as pests, is thought doubtfully of. In the foregoing notes I have not entered on this consideration, because as yet we do not know that the parasite insects have followed in the train of the fly.

autumn brood is dead, is a most important precaution, but, as it appears to be safe if put in after the beginning of October, this point is usually met in this country without special arrangements.

Dressings, and mechanical measures, as rolling, &c., may or may not answer, according to circumstances.

All measures to secure good hearty growth, such as may carry the moderately injured plants through attack, are very desirable.

So is rotation of crop, as the fly only attacks certain cereals specified.

Strong-stemmed corn is less liable to attack than kinds of which the outside is more readily injured by the maggots.

The above methods of treatment mitigate the violence of the attack, and if in the coming season we find this injury, which has now for over a hundred years caused from time to time such devastating loss in America, has settled down here, we cannot do better than study in full detail the reports of observation and agricultural treatment which have been found to mitigate the evil.

But meanwhile it is most urgently to be considered, WHERE DID THE ATTACK COME FROM? As in the hundred years and more that it has been in America, and about half that time that it has been known in Europe, we have no records of its presence as a crop-pest; and plenty of records of it not being present it is reasonable to suppose that there has been some special circumstance which has not occurred before to which we owe its presence. To find what this is would be to find how to free ourselves from a most dangerous crop-pest, and if all concerned would examine into the various ways in which it can have been conveyed on the land, and will continue this watch and report on it in the coming season, we may hope to learn the source of the evil.

I will venture to add that I shall have pleasure in receiving any communication on the subject, or samples of infested grain, and also samples of winter wheat or barley considered to be infested, and in giving all information that lies in my power on the subject.

Bibliographical References.

The following list gives the titles of some of the publications in which information will be found regarding the original identification of the species of *Cecidomyia destructor* by Thomas Say, and likewise regarding its habits, history, and distribution in America and Europe, and means of prevention and remedy. The most important and serviceable of the papers are those of the U.S.A. Department of Agriculture, and the papers by Dr. B. Wagner:—

Some account of the insect known as the Hessian Fly. By Thomas Say. Journal of Academy of Nat. Sciences, i., pp. 45-48, 1817.

The Hessian Fly; its ravages, &c. U.S.A. Department of Agriculture: Third Report of Entomological Commission. Washington, 1883. (Reprinted, with additions and corrections, from Bulletin IV. of the U.S. Entomological Commission. By A. S. Packard, jun., 1880).

The Hessian Fly; its history, &c. By Asa Fitch, M.D. Trans. of the New York State Ag. Soc., vi., 1846. Albany, 1847.

The Hessian Fly not imported from Europe. By Dr. H. A. Hagen. Canadian Entomologist, 197-207, 1880.

Introduction to Entomology. By W. Kirby and W. Spence. 1815-26, i.

Untersuchungen über die neue getreide gall-mücke. Von Dr. Balthasar Wagner. Fulda & Hersfeld. 1861.

Die neue kornmade. Von Dr. H. Loew. 1859.

Naturgeschichte der schädlichen insecten. Von V. Kollar. Wien, 1837. English translation by J. & M. Loudon, with notes by J. O. Westwood. London, 1840.

Untersuchungen über Insectenschaden auf den schlesischen getreidefeldern im Sommer 1869. Von Prof. Dr. Ferd. Cohn.

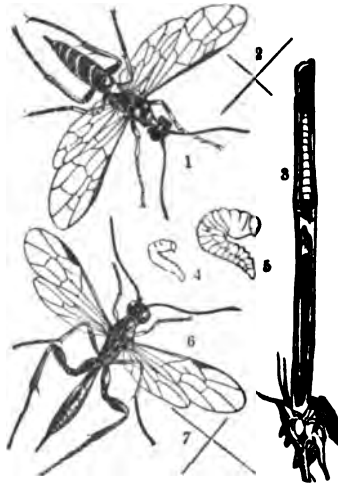
Die schädlichen insecten Russlands. Von F. T. Köppen. St. Petersburg, 1880.

Synopsis Cecidomyidarum. Von J. E. Bergenstamm und Paul Loew. Wien, 1876.

Die Praktische Insekten kunde. Von Dr. E. L. Taschenberg. Bremen, 1880. Pt. iv., pp. 9-14.

Die Pflanzenfeinde aus der classe der Insekten. Von J. H. Kaltenbach. Stuttgart, 1874. Pp. 734-741.

Corn Sawfly. *Cephus pygmaeus*, Curtis.



CEPHUS PYGMÆUS, Curtis.

1, 2, Sawfly, magnified, with nat. size; 3, stem containing maggot; 4, 5, maggot, mag. and nat. size; 6, 7, parasite fly, *Pachymerus ceciliator*, mag., with nat. size.

The injury caused by Corn Sawfly may be easily mistaken at a passing glance for that caused by Hessian Fly, as in both cases the

straw falls; but in the *latter* case it bends down at a sharp angle above one of the lowest knots; in the *former* (that is, in the case of injury from Corn Sawfly) the mischief is done by the corn stem being cut through about ground-level by the maggot which lies inside the stem; consequently the stem does not bend, but breaks clean off at the cut part.

Regarding this attack, Col. C. Russell wrote me, on the 20th of July from Stubbers, near Romford, Essex, regarding what turned out to be attack of *Cephus pygmaeus* :—

“I examined a lot of wheat-stalks like those I sent you. In two I found specimens of a very small insect; one inside the straw when I had opened and examined to the joint below, the other came out where the straw was cut in two on removing the sheath. They were long and narrow, and had a glistening appearance.”

On Aug. 12th Col. Russell forwarded two more specimens, which agreed with description of Corn Sawfly respectively in larval condition and in cocoon. The maggot was legless, with yellowish head and brown jaws. Col. Russell mentioned he had searched the wheat that morning and found “two larvæ of the kind which cuts the straw in two close to the ground. They were both *below* their cut. Though cutting the straw close down into the ground, I cut one larva in two. . . . The other larva is complete: as it is in a fine silk envelope, I suppose that it has ceased feeding, and is about to change.”

Relatively to distinctions observable between different methods of injury to straw, Col. Russell remarked :—“The sort which I now send cannot be distinguished from other fallen stems, except by pulling gently or feeling along with the finger-nail to the place where it has fallen. This is so close to the ground that when the straw comes away the stump is so close to the ground that it is apt to be lost sight of, and difficult to find again among the other stalks; and this is where the insect lies. It is therefore not easy to get the insect, especially as for one straw cut down by it perhaps fifty have fallen from other causes, as wind or weakness.”

A field of wheat at North Hall, Basingstoke, was reported by Mr. H. Purefoy Fitzgerald as being very badly infested by maggots, which were within the stems. The specimen sent accompanying proved to be the maggot of the Corn Sawfly; and on Aug. 25th Mr. Fitzgerald forwarded some wheat stems which showed on splitting up the straw where the maggot had worked and fed within.

The larva or maggot of the Corn Sawfly is of the shape figured at p. 26, of a yellowish white, with a horny rust-coloured head, and, contrary to the general condition of sawfly maggots, it is without feet, but at the tip of the tail there is a sort of tube-like appendage, or

extensile tip, which showed extremely plainly in Mr. Fitzgerald's specimen.

The life-history is stated to be for the parent sawfly to pierce the corn-stem and lay an egg within it. The maggot which hatches feeds within the tender straw, and, according to strength or circumstances, pierces through one or more knots, until when nearly full-grown it goes down again, and just about harvest-time cuts the straw through, or nearly through, with its strong jaws just about ground-level. It then goes down into the part below the cut, and there makes itself a kind of silken case (as observed at p. 27 by Col. Russell), in which it changes to the chrysalis-state, and from this the four-winged fly (figured at 1, p. 26) comes out in the following summer. The colours are chiefly black and yellow; the yellow is clearest and brightest in the male.

The damage is only partly caused by the sawing through of the stems. This causes them to fall, and makes confusion in the crop; but the great mischief is from the feeding of the maggot in the stem, having more or less stopped the proper formation of the ear. In the specimens sent me the marks and state of the stem showed very plainly where the maggot had been working within it.

As the maggot remains in its silken case down the pipes of the stubble left on the field, and the fly does not come out until the early summer of the following year the means of preventing recurrence of attack are very easy. If the stubble is scarified or skimmed so as to loosen it, and the plants then dragged and collected in heaps and burnt, the mischief is entirely put an end to. It would be worth while, where attack has been bad, to have the stray plants of stubble, which may have been left by the regular farming operations, hand-collected and thrown to the heaps for burning.

In this, as well as in Hessian Fly attack, it would be a most excellent way of getting rid of infestation, *if the thing could be managed*, to burn the standing stubbles after harvest. But the plan is difficult to carry out in this country for many reasons.

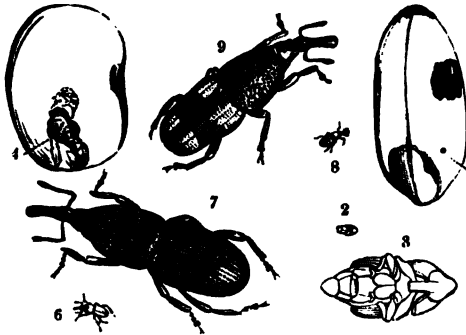
SCREENINGS.

Corn Insects of various kinds.

During the enquiries which followed on the first appearance of the Hessian Fly in this country during the past season, as to the possible methods by which this pest could have come amongst us, I was strongly urged to endeavour to direct attention to the great risk that is incurred of insect corn-pests being spread generally in consequence of the increasing use of screenings or injured corn, foul with all sorts

of insect-presence, being sold at very low rates, in some cases as feed corn for horses, sometimes as poultry-food. The samples showed me were what is termed alive with insects.

With regard to importation of Hessian Fly attack in chrysalis form, in this manner it appears unlikely, as Hessian Fly is not known



Calandra granaria; *C. oryzae*.

6, 7, Granary Weevil; 2, 3, pupa, nat. size and mag.; 8, 9, Rice Weevil, nat. size and mag.; 1, corn, showing puncture of entrance and hole of exit of weevil; 4, infested maize-grain.

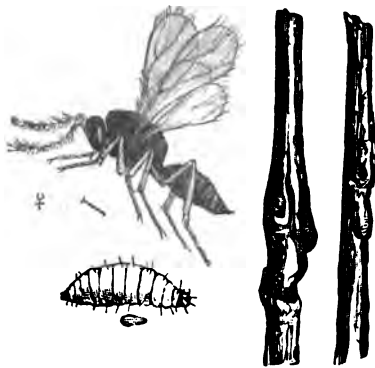
to attack oats, and, in the case of barley and wheat, the chrysalids would not be at all likely to be found in fairly cleaned grain. Investigation has shown that the chrysalids may be found in the dust and rubbish beneath the machine, but not, so far as we see at present, in the chaff or the cleaned corn.

But quite independently of Hessian Fly, the increased amount of spread of all the pests, insect or fungoid, which may be in these screenings, is a matter calling for consideration, and all the more because—though each sufferer sees what is going forward—there is a strong and natural objection to give information which may cause business annoyance; and it is most difficult to procure full details.

On application to the manager of a large steam mill, where imported wheat is ground, he obliged me with a series of samples showing the different kinds of refuse now sold cheap, mostly for poultry-food. These samples were of four kinds, known as "rubble," which consists of bodies larger than the wheat-grains, as lumps of earth, maize, beans, &c.; first and second screenings, which consist of broken corn, bits of straw, chaff, &c., and other bodies smaller than the wheat-grains, or which may (like straw) pass by reason of their fineness through the screens; and, fourthly, there was "black dust," which is literally, for the most part, mere dust driven by a blast from the grain in process of cleaning. In this black dust there

appeared to be very little insect-presence, nor did it appear to be of any use; it was formerly got rid of by being floated away down the river, until river regulations prevented this method of destruction.

In the screenings I found many granary weevils, besides other beetles, and in the rubble a good many lumps of grain, spun together by granary moth-caterpillars. Besides these there were in some of the samples short lengths of straw, which were quite long enough to convey the "joint-worm," one of the worst American corn-pests, and likewise there was the dangerous fungus "Ergot," which is objectionable as poultry-food, or as being thrown where it can be carried on the land. The various kinds of grain-beetles infesting corn and other stores is an old trouble, but the presence of bits of straw in which the "joint-worm" or maggot of the *Isosoma hordei* may perfectly easily be imported into this country is an evil which (as apparently there is no way of preventing the matter) it is as well to give timely warning of, and I therefore quote below some abstracts from the account given of this attack in the Report of the Entomological Society of Ontario for 1872, prepared by the Rev. J. S. Bethune, President of the Society.



ISOSOMA HORDEI, Harris.

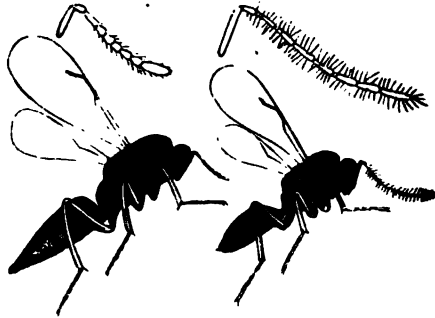
Joint-worm fly and maggot, magnified, with nat. length. Galls on wheat-stems caused by joint-worm. After figures in paper quoted above.

This attack occurs to wheat, rye, and barley. and is known as that of the "joint-worm," by reason of the maggots feeding within the corn-stems, generally above the first or second joint. The female fly inserts her egg into the straw with her long ovipositor, and places one egg after another till laying is completed. This was observed about the 10th of June. The eggs soon hatch, and the maggots, which are footless, but furnished with jaws, begin to feed. Swellings or galls form above the joints in consequence of the presence of the maggots within, but, as these are wrapped in the sheathing-leaves, they are not observable until the leaves have been stripped away (see figure).

Addendum to Tenth 'Report of Observations of Injurious Insects,' p. 30.

In adapting the figure of *Isosoma hordei* on the accompanying page, a misrendering of nervures occurred, which, to my great regret, was not corrected before publication.

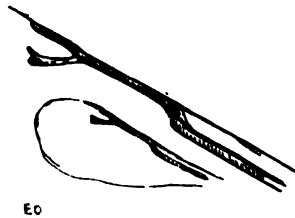
I now therefore give a figure of the male and female *I. hordei* (by kind permission from page 60 of the Second Annual Report of the Entomological Society of Ontario), with the wings taken as transparent objects, so as to show the nervures, but neither the bristles, nor somewhat vein-like appearance caused by absence of bristles, nor possible vein-like folds.



ISOSOMA HORDEI, Harris.

Female and antenna; male and antenna (all much magnified). Nat. length of fly about one-tenth of an inch or rather more.

Having, through the courtesy of Mr. James, Fletcher, Consulting Entomologist of the Department of Agriculture of the Dominion of Canada, been put in possession of a good specimen of the insect, I add a sketch from nature of the fore wing (as a transparent object), much magnified, together with a figure still more magnified, of the peculiar neurulation. It will be seen that the subcostal nervure, after uniting with the fore edge of the wing, runs along it for some distance beyond the point at which the side vein is thrown off. . . This side vein, as usual with the *Chalcididae*, slopes obliquely into the disc of the wing, expanding gradually to about twice its original width, and is emarginate at the extremity, the side of this extremity towards the disc of the wing being smallest, the other prolonged into a short point. The nerve from which it branches, as seen under a one-ninth object-glass, stops abruptly so as to form, with the side nerve, a fork with arms of equal length.—E. A. O.



80

CORN.

The damage is caused by the sap being abstracted both to feed the maggots and to form the galls, and the ears are consequently stunted, blasted, or shrivelled. The amount of damage may be a third or half the crop, or even the whole may not be worth cutting. It has been recorded in several parts of the United States.

The important part of the life-history to us is that the maggot, when full-grown, "for the most part continues unchanged till the following spring, when it assumes the pupa-state, and finally emerges as a four-winged fly in the month of June." (The fly is about the tenth of an inch long, with four transparent wings, and black, with legs of some colour between black and pale yellow).

From the above circumstance of the maggots remaining in the straw during the winter, there is a perfect possibility of the pest being transported either in imported straw, or relatively to our present consideration in short lengths of injured broken-off straw such as I have found in "rubble" or screenings.

The attack is of old standing in the States, but, as from some cause unknown we have already had one attack of old standing recently brought amongst us, it can at least do no harm to be on the alert in time against a second; and as in the course of last season information was given me of corn being observed with holes in the stems, there may be already reason for special watch.

The attack may be easily distinguished by the swellings or galls above the lowest joints (with round holes in them in case the insects have escaped), and also by the fly being *four-winged* and black.

Amongst the various kinds of corn and meal beetles to be found in screenings or corn stores, the most hurtful kinds are the granary weevils, figured at p. 29. I have seen them in such numbers that enough to half fill a good-sized wash-hand basin was swept up at once from under a heap of corn in a granary in Gloucestershire, and had opportunity of watching their powers of spreading so as to infest all neighbouring outbuildings.

The following observations regarding them were sent me during last season by Mr. G. L. Purchase, of Chichester:—

"Weevil have been very numerous in a corn-store here; they came there in wheat. The wheat was heaped on a wood floor. When it was turned the weevil were found in immense numbers; they spread over the floors, walls, and ceilings of the store. The corn had become very hot. When it was turned the weevil clustered on the top for a time, blackening the surface.

"An endeavour to kill the weevil by fumigating the store has not been successful. Those about the walls survived. Paraffin kills them, but it is said carbolic acid does not.

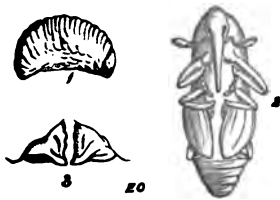
"Weevil are common in corn-mills, but, as the corn is frequently

changed, and the mills swept, the weevil do not become numerous; but they are bad in a corn-store.

"What will happen if they are not got rid of? It is said they cannot bear cold; but if the insects die in the winter will their eggs be hatched next spring or summer?"

There are two kinds of weevils often met with in granaries; the *Calandra* (*Sitophilus*) *granarius* (see figs. 6, 7, p. 29, natural size and magnified), and the *C. oryzae*. The first is the British or common granary weevil, and is of a chestnut or pitchy colour, and rather longer than the Rice Weevil, which last is further distinguished by usually having two orange-coloured patches on each wing-case. The method of life appears to be exactly the same in each case, and both kinds feed on wheat.

The egg was formerly supposed to be inserted into the corn by means of a hole formed by the proboscis of the female, but in observations made by Mr. Fitch and myself (of the habits respectively of the common weevil and the Rice Weevil) we found that a very minute



puncture was made in the corn, which Mr. Fitch considered to show that the egg was laid on the grain, and the minute maggot eats its way in. Only one egg is commonly laid on one grain, and the number laid has been found in the case of the *C. granarius* to amount to 120 in one week. The maggots are white, footless, fleshy grubs, with yellow or

chestnut-coloured heads, and strong jaws. The figure gives a sketch from life of the maggot (and its jaws) and the chrysalis of the Rice Weevil. The maggots feed and change to chrysalis within the grain, from which in due season the weevil creeps out.

The Rice Weevil is imported in vast quantities, and I have seen sweepings of corn-ships, known as "Indian dust," procured for me at Maldon by Mr. E. A. Fitch, alive with it. They have been stated not to be able to breed in this country, but from my own observations I have found that this is not the case. Eggs were laid and maggots fed in the grain, from which many beetles developed, but there is no reason to suppose that they breed here freely like the British kind.

Warmth is so much needed by the granary weevils that it has been observed that the common *C. granaria* will not pair when the temperature is below 52 degrees, and the beetles will live in the heaps of corn in hot weather; but "when the mornings begin to be cool all the weevils will desert the corn-heaps"; . . . "they retire into the crevices of the walls, into the cracks in wood and planks," &c. (see Curtis's 'Farm Insects.').

The above remarks show the reason why thorough whitewashing, which gets at the weevils in the chinks where otherwise they would rest in peace till ready for further mischief, is of such great service.

The following observation by Mr. E. A. Fitch, of Brick House, Maldon, on the subject of prevention and remedy of this granary pest, are excellent :—

“ Cleanliness alone will do the required work, and this requires to be thorough to cope with such a crevice and cranny-loving hybernating insect as the *Calandra*. Frequent lime-washing and scrubbing (with soft-soap) of granaries, and plastering of all uneven wall surfaces, and asphaltting or concreting of all uneven floors, the free use of the dressing-machine or blower, and frequent sifting or turning over of the grain, are the only remedies against weevil-attack. It is also necessary to guard against mixing sound wheat with any containing ‘weevil,’ except for immediate grinding; also to see to the destruction of all rubbish and tail-corn, in which it is possible for the beetles to live or breed.”*

The following information regarding granary weevils (also taken from the above-quoted paper) is of so much serviceable interest that I give it also in Mr. Fitch’s own words :—

“ The wheats which are now affected to any very serious extent are the Indian, and I have often seen samples of the excessively dry Calcutta and South-eastern Asian wheat in which it was almost impossible to find a perfect corn, the valuable starch of the kernel being consumed by the destructive little weevils. *Calandra* like wheat and many other useful products, with their attendant evils, is undoubtedly an introduction from the East.

“ Weevily wheat is invariably dressed after landing, and a large percentage of the little beetles are thus screened or blown out; but, of course, many of the insects resident in the corn, and all in the larva or pupa state, escape, the kernel not yet being light enough to be separated. When the cargo is very badly affected,—when the whole bulk seems alive, as I have myself seen them on very hot summer days,—it is a common practice for merchants to spout it, *i. e.*, to shoot the grain down a spouted trough, in which at the angle is a wire sieve with the meshes large enough to let the weevils through, but not the corn, which runs into the granary, or into sacks, as the case may be.

“ By such means the quantity of weevils and dust sifted out is enormous, and this appliance is generally so situated at the wharves that the beetles are deposited near the edge of the wharf, or even in the river-bed, and, if not naturally washed away at high-tide, are

* See “ Granary Weevils,” by E. A. Fitch; the ‘Entomologist,’ No. 189, February, 1879. Simpkin, Marshall & Co.

swept into the water, their destruction being thus easily accomplished. The great heat generated in a bulk of weevily corn is caused by the dust arising from the borings and frass of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot; then they are especially lively on the outside."*

Other kinds of beetles, and various other kinds of corn-destroying insects, are to be found in screenings, refuse grain, neglected granaries, and the like places, of many of which the life-histories are fully known, and to some of which accounts the very significant remark is added by one of our best German writers on injurious insects, "Spread in course of traffic."

So far as dry corn or meal-feeding kinds are concerned, the mischief is probably limited to the evil caused by their spread in the purchaser's own stores or immediate neighbourhood. But with the kinds of which the maggot-state (that is, the feeding and destroying condition) is passed in the living corn crops, it is quite another affair. If bits of straw (such as I have before me in screenings), or knots of webbed corn containing chrysalids, or refuse containing infection in any other form, are thrown about in our farmyards, or stored where the evil may take wing and fly thence to our fields, an amount of trouble may arise well worth consideration beforehand.

"Tulip-root"; Eelworms. *Anguillulidæ* (? species).



Oat-plant, with "Tulip-root" disease.

The disease known as "Tulip-root" in Oats has either increased very much in amount during the past season, or has been very much more observed than in previous years.

* See p. 43 of paper quoted above.

The chief outward sign of this diseased growth is an enlargement of the base of the stem of the Oat-plant into a bulb-like form, from which the attack takes the name of "Tulip-root," although the lower part of the diseased plant, taken altogether, much more resembles a "duck's-necked" onion. Round this swollen base there are usually a number of short stunted pale-coloured shoots, each shoot crumpled and folded on itself, and the collection altogether forming a mass of rough irregular ends not unlike in appearance to a worn-down broom, whence possibly arises the name of "besomed" Oats, occasionally given to this form of attack.

These two conditions (that is, the swollen stem and the encircling distorted and stunted shoots) are commonly present, but when the diseased plants sent me were fully grown I have not found that as many stunted side-shoots were as observable as before; also in the very early stage of the attack (as seen in specimens of young winter Oats sent to me about the middle of November) I did not find even the "Tulip-root" swelling definitely formed. There was only at that time a small swollen knot or gall a little way up the stem. The infested plant was still in such early growth that, though many Eelworms were present, the diseased formations which they give rise to were only just beginning to appear.

Specimens of injured Oat-plants were sent to me at dates ranging from July 6th to Nov. 16th, thus showing the progress of the disease in the plants from about six inches high up to such maturity as they reached, and likewise (by means of the autumn-sown Oats) showing the appearance of the attack in an early stage.

The "Tulip-root" disease (so far as was reported) was much more prevalent during 1886 in Scotland than in England; it occurred in the shires of Renfrew, Ayr, Lanark, Linlithgow, and also in East and Mid Lothian; and the fact that these counties, or portions of counties, lie together (as, it might be said, "in a ring-fence") may prove worth notice. It also occurred in Aberdeenshire, and also in the English counties of Yorks. and Berks.

As this very peculiar attack has not yet been much brought forward, I examined the specimens sent very carefully, to make absolutely sure that Eelworms were always present in the diseased plants, and have given the notes of examination in detail, although each is almost a repetition of the others, as the mere fact of this exact similarity of presence of Eelworms and of diseased growth always accompanying it is of practical use.

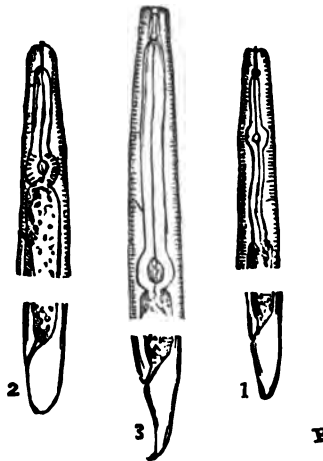
The inside of the bulb-like stem was more or less hollow, the surface of the cavity was often spongy, and, as the disease became worse, the surface became yellowish or brown with decay. On scraping away some of this spongy or brown matter I found this to be

the head-quarters of the Eelworms. I found wormlets also outside the bulb, amongst the sheathing-leaves, and likewise in the contorted stunted shoots. Eggs were not always present, but sometimes they were plainly distinguishable. (For shape see figure, p. 48.)

In the case of the very young Oats sent in November, I found Eelworms of various sizes present, but only a few that were apparently fully grown, and the "Tulip-root" growth was not then developed.

The Eelworms which cause this attack are excessively small, white, transparent, thread-like worms, so minute as to be invisible to the naked eye, and hatch from eggs. They belong to the family of *Anguillulidæ*, but at present we are not even sure which genus they belong to, nor (it seems to me) *whether there may not be several kinds present.*

The appearance of the diseased plants corresponds with that caused in Germany by the *Tylenchus dipsaci*, Kuhn. This species is very nearly allied to the kind which causes the purple galls in wheat known as "Ear-cockles," figured at p. 48. Several kinds of Eelworms are known to be found at the roots of Oats, and the figures of some of these given below may assist those who have a powerful microscope in making out what genus at least this pest belongs to.



ANGUILLULIDÆ.

- 1, *Tylenchus obtusus* ; 2, *Aphelenchus avenæ* ; 3, *Plectus granulatus*, of Bastian
(all enormously magnified).*

It will be observed that the figures only give a portion of the head and the tail-ends ; if the whole was present the wormlet would have

* The three species of Eelworms represented above are copied from the figures by Dr. H. Charlton Bastian, F.R.S., &c., given in Plate X. of his "Monograph on the *Anguillulidæ*," published in vol. xxv. of the 'Transactions of the Linnean Society.'

to be represented (at its present magnified width) as from at least eight or nine inches to a foot long. In fig. 1 it will be observed there is a spear or sharp point, with a large base, a swelling about half-way down the gullet, and the tail is blunt without a sucker. Fig. 2 has a spear without a large base, and the swelling of the gullet is quite at the lowest end; the end of the blunt tail has a very small sucker. In fig. 8 there is no obvious spear, the gullet is differently shaped, and there is a small sucker at the end of the pointed tail. These belong to three different genera or divisions as we may call them, and these and one other are alike in the power they possess of prolonged life, and recovery after being dried.* The common Eelworm of the wheat cockle-gall has been found to recover after being torpid for four or five years, and this capacity may have something to do with the appearance of patches of diseased growth in the Oat fields, where there has been no treatment to account for them in the preceding years (see map, page 42).

The following notes are arranged as nearly as possible in order of date :—

On July 6th Mr. Edm. Riley, of Kipling Cote, Market Weighton, sent specimens of Oat-plants, with the following remarks :—"I have sent you a sample of diseased Oats. I have not had any on this farm before, but it was very common on some lands last year. This fine weather is improving crops much."

These young plants were about ten inches high, the lower part of some of the main shoots was swollen into a bulb-like form, and the others contorted into irregular knotted shapes round the base of the tulip-rooted stem. These were mostly white, irregularly thickened and folded to and fro, as shown in the figure, p. 84. On opening the diseased parts, and more especially the swollen bulbs, it was observable (with the help of a magnifying-glass) that the inside had a sort of crumbly appearance, as if sprinkled with damp powder, and, on scraping some of this off and examining it with an inch-focus object-glass, it proved to be full of Eelworms in perfect vigour, with large numbers of eggs amongst them of the shape figured at p. 48. These *Anguillulida* were long, narrow, transparent wormlets, moving about in the glycerine in great numbers. The diseased Oat-plants sent did not look as if they were likely to get over the attack.

On July 16th Mr. Alex. Watson, of Dreghorn Mains, Colinton, near Edinburgh, forwarded specimens of Tulip-rooted Oats, with the mention that the disease was very prevalent in the county, and some remedy urgently desired; and on the 26th he communicated further as follows :—

* For source of above information, with full details, see Monograph by Dr. Bastian, previously quoted.

"The field where these specimens grew bore two good crops of hay last year. This year, when Oats were sown, we gave it 8 cwt. per acre of an equal mixture of sulphate of ammonia and superphosphate. Considering the dry cold season it is a fair crop, where free of disease. The last white crop was chiefly Wheat, but about five acres were Oats, and it is there the disease is worst, showing that growing the same kind of crop too frequently is the cause of the disease. . . . It has occurred to me that it might be a good plan to pickle the seed with blue-stone, the way we do with Wheat."

On examination of the Oat-plants forwarded by Mr. Watson I found them, as usual in this attack, swollen at the base, which was surrounded with small shoots, contorted from being checked in growth, and bent back to and fro on themselves. The first of these contorted shoots which I opened was slightly spongy in the middle, and a scraping from this surface showed the presence of *Anguillulida*. In scraping off the surface of the leaves as I removed the sheathing of the diseased bulb, I found just a few Eelworms, and in the small central cavity containing the minute growth, which I take to represent the future ear, I found a white mouldy look on the side of the chamber, which, on being scraped off and examined under the microscope, proved to contain many Eelworms, mostly of rather small size. I also found them in the decayed matter in the centre of the stem of this plant, lower down, about ground-level.

About ten days later (that is, on July 26th) specimens of diseased Oat-plants were sent by Mr. T. H. Cundy from the Ainsty Estate Office, Wetherby, with the mention that they were samples of the condition of about five acres of Oats taken out of the centre of a large field. This field was on magnesian limestone, with a fair depth of soil,—in Turnip the year before (pulled off); these were a splendid crop, grown with fold-yard manure from covered yards. This part of the field was manured again for these Oats, it being very poor and lying near the rock; it had only come into the writer's possession in the previous year. The Oats came well, but went back after two months of continuous dry weather. These Oats were very badly infested with Eelworms of various sizes; they swarmed too numerous to be counted, and one egg at least was visible. The diseased plants were as usual "tulip-rooted" in shape at the base with distorted shoots round; also on one stem there was a gall of twisted shoot growing from it a little above the base.

On July 19th Mr. Richard Brown furnished me with samples of diseased Oat-plants taken from two fields at Hill House, Kirk Newton, Mid Lothian. The plants from one field were much worse infested and their growth much more injured than those from the other. In those from the first-named field I found the plants were about six to

nine inches high, suffering from the usual form of diseased growth,—that is, the base swollen into "tulip-rooted" shape, with small crumpled-up shoots curled round the base for about half an inch in height.

On opening one of the curled shoots I found it was of a kind of spongy white condition within, in which I found a few of the worm-lets; the main stem of the same plant was swollen and hollow for about three-quarters of an inch up, the cavity being lined or partly covered within at the higher part with chestnut-coloured powdery or spongy matter. On examining this under the microscope I found that it was swarming with Eelworms, but I did not distinguish any eggs; Eelworms were present in the dark brown decayed matter at the base of the cavity, but there were not many specimens noticeable in this part.

I now tore off a piece of the inner side of a leaf-sheath about an inch and a half higher up, and where, excepting for being a little swollen, the plant looked well-coloured and healthy; and here, on taking a thin film of the silver-paper-looking surface, I found, with an inch power, that the Eelworms were also present. On cutting off a length of the central shoot at two to two and a half inches from the base, and unrolling just the central part, I did not distinguish that there were Eelworms present.

Eelworms were present in other Oat-plants taken from the same field, mainly in the discoloured yellowish part near the base of the stem, but I did not find—or rather could not be absolutely certain of the presence of—eggs. [The above specimens were examined in glycerine with inch and quarter inch powers.—ED.] The Oat-plants from the second field contained Eelworms also, but to a lesser amount, and the plants were less swollen.

With regard to these crops Mr. Brown mentioned:—"They are both crops following Turnips and Potatoes. Our crops following hay are not *this* year affected, those fields having been hitherto free of disease. A part of one field treated last spring with lime shows no abatement of the disease."

Mr. Brown further mentioned, on July 26th, "that on observing the braird not looking well about a month ago, the worst parts received a top dressing of nitrate of soda, but this did not appear to check the progress of the disease. The plants which you describe as not quite so badly affected were taken from a field which was a little later in being sown than the other."

On Aug. 28rd Mr. Brown reported the widespread prevalence of the attack:—"I find that disease is more widespread than I had thought. I have learnt of cases this year in Lanarkshire, Renfrewshire, East Lothian, and Aberdeenshire; in this district it is very prevalent, as

also in the adjacent county of Linlithgow." Also, as below quoted, he again noted that no benefit resulted from application of nitrate of soda as a remedy; benefit, however, had followed on use of sulphate of potash. He noted that a farmer, "after trying, on a field badly affected with the disease, a top-dressing of nitrate of soda without beneficial effect, applied half a cwt. per acre of sulphate of potash, which immediately checked the work of destruction, and brought the plant away, so that the crop has reached quite an average. A small portion not treated in this way is a failure from the disease. It may be that sulphate of potash, applied when the Eelworms are active, acts as a poison. It does not appear, so far as I can learn, to harm them when applied with the seed."

"I cannot find any indication that the extent of the attack is dependent upon the crop preceding the Oat, or of any other cereal crop being affected in a similar way. Neither can I find anything to show that the disease is communicated by means of straw from an affected crop applied as manure."*

On August 22nd Mr. Robert Drennan wrote to me from Goatfoot Farm, Galston, Ayrshire, as follows:—"A good part of my farm is holm land, in fair condition and wrought on the four-course system, which means a crop of Oats, a green crop, a crop of Oats or Wheat, and a hay crop. For several years I sowed Beans as part of the green crop, and I found the 'Tulip-root' much worse on the plot where the Beans were; so I gave up sowing them, and, although the land has gone through a course of cropping, the beaned plots are worse than the other portions of the field still."

Mr. Drennan further observed that he had thought that Beans preceding Oats was a cause of the attack, but also he mentioned that where the Beans were sown he took an Oat crop following. "The other portion of the field was Wheat, which meant two crops of Oats in the four years on the Bean plot, and one Oat crop on the other."

Relatively to the point of *Anguillulida* being possibly found about both Oats and Beans, he forwarded to me some stumps of Bean plants off land where "Tulip-root" had been bad the previous year. I examined these carefully for presence of "Tulip-root" *Anguillulida*, but could not find any present either in the roots or lower part of the stems or attacked earth,—in fact, they appeared to be completely absent. Mr. Drennan notes that he sowed his "Beans with about 8 cwt. to the acre of sulphate of potash and other manure. If sulphate of potash be a cure, that may account for the absence of the worm."

I take the liberty of inserting the following observations on the

* Observations as to methods of transmission of attack, and length of time which it may continue in the land, will be found at pp. 45-47.

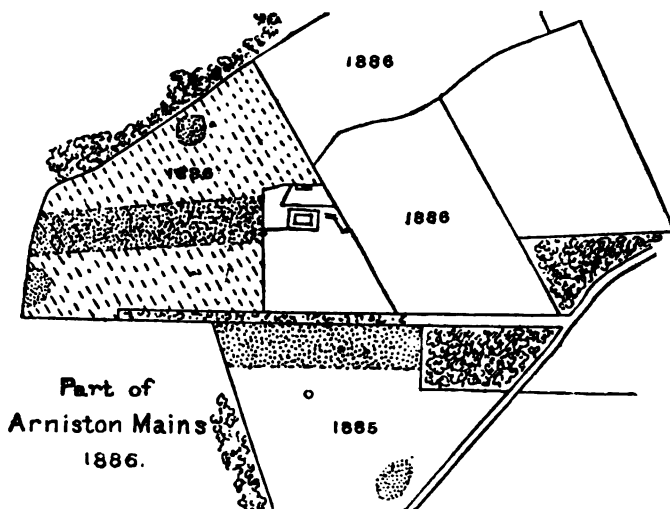
condition of the Oat crops at the Highland and Agricultural Society's Experimental Station at Pumpherstons, reported on the occasion of the annual visit by members of the Society, as it is of great interest regarding the use of phosphates in connection with "Tulip-root" disease. I am obliged to the Editors of the 'North Brit. Agriculturist' for a copy of these notes which appeared in the above Journal:—

"The crop this year is Oats after Beans. Owing to the excessive drought this season the Station, in common with many fields under Oats, has suffered considerably, so that what is called by farmers 'Tulip-root' is somewhat prevalent. The observations drawn from this disease on the Station show that where the most liberal application of manures was made the disease was at its lowest, while those parts of the Station from which manures of a certain kind had been withheld, or only sparsely laid on, were most affected by the disease. The best plots on the Station were those to which soluble phosphate had been applied. Amongst undissolved phosphates bone-meal was, upon the whole, most effective; but there was little difference between dissolved phosphates from any source. Muriate of potash has this year produced a better result than sulphate. Amongst other manures, fish-guano, which hitherto has not been prominent, has produced one of the best crops on the Station, and nearly free from disease. Dr. Aitken suggested that this was probably due to the residue which had been left in the ground from the manuring of former years, this plot having been noticed to be improving year after year. The plots manured with superphosphates show, as in former years, that it is not advantageous to use phosphates whether too little or too highly dissolved."

The following notes, with the illustrative sketch-map accompanying, show attack occurring in two fields (in two different years), on areas so perfectly regular in form that the two strips might have been separated by a ruled line from the rest of the fields. Mr. Dundas, after noting that he had heard of four fields in the neighbourhood affected by "Tulip-root," remarked:—

"I enclose a tracing of part of my farm on which the disease has appeared, this year and also last year. On the plan the places marked in brown are those affected. You will see its course last year in the field marked 1885. This year the three adjoining fields marked 1886 have been under Oats, but only one of the three has been affected, the crop being Oats after turnip. I have made every enquiry about the dunging, especially asking if the disease had been noticed, on however small a scale, in the years before 1885-86, but I am assured it had not been noticed; because in that case the infection might have been given to the land through diseased straw in the dung. Further, my steward has marked in the affected field 1886 the direction of the

ridges (and which also would be the direction in which the heaps of dung would have been laid down), but the track of the disease" (as shown by the dotted parts) "has no relation to the way in which the



The two infested strips and three small patches are shown by dots.

dung was laid down on the land. The other two fields marked 1886 were Oats this year, a level crop and free from disease."

The continuance of this attack up to the maturity of the crop, or rather to the time when, if all had been well, it would have matured, was shown by the specimens of Oat-plants sent from Arniston, Gore-bridge, Mid Lothian, on Sept. 24th by Mr. Robert Dundas, with the accompanying observations :—

"I enclose you a sample of Oat-roots from a field on my home farm, of which four acres out of twenty-two have been affected. The soil is a sandy clay; the crop is Oats sown out with grass and Clover seeds after Turnips." . . .

The stems proved to be in some instances hollowed or filled with decayed matter down to the roots, and the inside of the side shoots was also occupied by decayed matter. On examining this damp powdery-like matter I found many *Anguillulida* still alive and some eggs. In one of these I detected the developed wormlet folded on itself within. The Oats were much damaged, for many of the shoots were stunted and quite killed,—fairly gone in brown decay and black within,—and in this decayed matter I also found wormlets.

In this case, and also in one or two others, there was presence of maggots of some kind of small two-winged fly in the infested stems, and in one instance this occurred to such an extent as to appear at first to be the reason of the plant going off; but the coincidence may

conjecturally be caused by the fly being attracted to lay its eggs by the decayed matter in the infested plants.

The following observation refers to the presence of Eelworms in the young winter Oats. On Nov. 18th Mr. W. Farrant wrote from Stokes Farm, Wokingham, Berks, as follows :—

"I herewith enclose a few plants of winter Oats. I put them in after one year ley of artificial grasses, mown once, the after-math fed. I drilled three bushels per acre, and I should say quite one-third are turning yellow as the sample sent, and some are eaten off. . . . It appears to me to be eaten off inside, about half an inch from the seed. . . . I may say that I anticipated wireworm before sowing, and sowed 10 bushels soot, 8 cwt. salt, and 2 cwt. fish-bone per acre. Sown behind the drill and harrowed in with the seed, and rolled with a light roller."

On Nov. 16th Mr. Farrant furnished me with some more specimens, and I examined both the tops and the rootlets. There were no Eelworms observable about the rootlets, but on breaking up the sprouted grain in water together with the husk surrounding it, I found Eelworms of various sizes numerous present, and they were also to be found in numbers on breaking up the stem about half an inch above the seed. There was no growth advanced far enough to have gained the "Tulip-root" form, but a small knob of thickened growth was already observable at about the highest part of the diseased, or rather the infested, portion of the stem just above the grain. The Eelworms were in very active condition, and were in some instances apparently fully grown, but the larger number were from about one-sixth to half the size of the full-grown specimens.

The above note from Mr. Farrant completes the series of observations of presence of Eelworms in Oat-plants, or amongst the lower part of their leafage, from *almost* the first start of the plant from the seed up to maturity; and if we could have some specimens of Oats just at sprouting-time itself for examination, it would be likely to throw a good deal of light on the first stage of possession by the Eelworms. If we found them present in the husks of the seeds it would appear that they had come there either from the infested ground or manure in it, or from the seed itself. We have no reason to believe they are in the substance of the seed, but (wherever they come from) it appears worth consideration whether, as suggested by Mr. A. Watson at p. 88, the use of a sulphate of copper steep, commonly known as blue-stone, or pickle might not be of great use. The poison or flavour of the pickle would be likely to remain quite long enough about the grain to be a powerful deterrent to attack. If on examination of the soft sprouting grains the eggs of the Eelworms, which are very easily known by their shape, should happen to be found, we then should

have the key to the attack; but, as we have no notes of Oat-grains being galled like those of Wheat, it does not seem likely that we shall find the attack comes from inside the grain.

On looking over the observations we find that the "Tulip-root" disease has been found to occur to Oats after Turnips, Potatoes, and Beans, also on land broken up after Hay, and it is specially noted in one instance that the part of the field which had previously been in Oats was the worst attacked by "Tulip-root" in the successive Oat crop.

The above observations point at least to probability of the Eelworms remaining in the ground, or being brought on to it in infested straw; but we need details and further observations.

It will be observed that lime, nitrate of soda, soot, and salt have not proved of use in warding off attack.

In any further observations with which I may be favoured, I should be particularly glad to know whether the attack has been limited (as in that of which the plan is given at Arniston Mains) to any particular part of the field; and also to have details of previous crops and manures for the preceding five years, this being the length of time to which it has been proved that the life of one kind at least of the common crop Eelworms may be extended.

In the above report it will be noticed that I have limited myself almost entirely to observations on the diseased crops, as I had not then the very high microscopic powers needed for any trustworthy examination of such excessively small bodies as these Eelworms. I could clearly distinguish that the egg was of the shape figured at p. 48, also that the largest-sized Eelworms were furnished with a spear, but whether this had a trilobed base, or, in fact, any swollen base at all (see figs. and description, pp. 86 and 87), I had not then means of observing. Now I have procured these, and shall be very glad of any specimens with which I may be favoured, either of Tulip-rooted Oats or of "going off" Clover. From my own observations of injury and from information now received, I think it very likely that a searching examination of diseased Clover might show Eelworm-presence of the same kind as the "Tulip-root" Eelworm, and infectious from one plant to the other.

But further from the great difficulty of procuring any reliable information in England as to the nature and treatment of the "Tulip-root" attack to Oats, or the precise species of Eelworm which causes it, I ventured, whilst the previous pages were going through the press, to apply to Dr. J. G. de Man, Conservator of the Museum, Leyden, now resident at Middleburg, in the Netherlands, well known for his researches regarding the *Anguillulida*, and beg to acknowledge with

many thanks his prompt and courteous, as well as most efficient, attention to my request.

Dr. de Man was good enough to examine some specimens of diseased Oat-plants which I forwarded to him, and, besides a few living *Anguillulidæ* of the genera *Dorylaimus*, *Cephalobus*, and *Rhabditis*, which he considered to be living on the outer surface of the plant, "probably in small earth-particles adhering to it," he likewise found *Tylenchus* present in the plant, but nearly all dead. As all examined were young and not yet developed, absolute certainty could not be attained as to the precise species, but it was presumable that they were of the *Tylenchus devastatrix*, Kuhn, which is one of the synonyms of the *Anguillula dipsaci*, afterwards the *A. devastatrix* of Kuhn, of which the attack is shown in the following extracts from Dr. Kuhn's treatise to be like that we are now suffering from in Britain.

In this matter it is of great importance to ascertain the kind of Eelworm which is present relatively to the extraordinary powers of prolonged life possessed by some of the divisions of the great family of *Anguillulidæ*; therefore, to know that our kind is a *Tylenchus* is of much use.

In the following extracts from Dr. Kuhn's treatise it will be seen how nearly the German attack to Rye and Oats corresponds with ours, and, though it has been mainly reported from observations on Rye, that the treatment is equally applicable to either crop.

The following notes and extracts up to p. 47 are extracted from Dr. Kuhn's pamphlet of observations on 'The Worm-sickness of Rye':—

This disease, which is known as "Stem-sickness," or shortly as "Stem," "Knob," or "Root," agrees very exactly in its effects in the most marked form with our "Tulip-root." The experiments and observations mostly refer to Rye, but Dr. Kuhn has found by minute examination that it is one special kind of Eelworm (formerly observed in Teasels) which causes the disease he reports on in Rye and Oats, and likewise attacks Clover, Buckwheat, and the Fuller's Teasel. For this reason he changed the name from *Anguillula dipsaci*, or "Teasel Eelworm," which had ceased to be appropriate to *A. devastatrix*, as showing its widespread injuriousness.

This special kind has been found by Dr. Kuhn to regain vitality if moistened with water even after two years laying up dry. But further, which is enormously important to the present subject, he states that "in damp earth they preserve their power of living still longer, even if their food-plants should perish. This circumstance is to be attended to in combating the Eelworm disease."—J. K.

All measures found serviceable for prevention of this "Stem" or "Stock" disease turn on observed habits of the Eelworm.

This kind is found by Dr. Kuhn to infest Rye, Oats, Clover, Buck-wheat, Fuller's Teasel, and also the field-weed often met with in chalky fields, known as "Corn Bluebottle."* As far as is known it does *not* infest Wheat, Barley, Peas, or Flax. The fact of infection being carried in worm-infested plants to some kinds of corn but not to others, was proved by the following experiment of Dr. Kuhn's. He buried small pieces of infested Teasel-heads an inch and a half deep in the ground, and sowed over them different kinds of Wheat, also Barley and Rye; and of these crops the Rye was infested, but *not* the Wheat or the Barley.

Rotation of crops is therefore very important, but as it has been proved that the Eelworms can live on in the land, even without their own special food-plants, the following treatment, which is advised by Dr. Kuhn for burying them so deeply down that they can do no more mischief, is well worth consideration :—

"The surest remedy for worm-sick fields consists in late ploughing, sixteen or eighteen inches deep. By this treatment the upper layer of earth with the contained *Anguillulida* is buried deep, and is covered with a full spade's depth of the under soil. The treatment must be carried out in autumn, and in the next spring cultivation rich manure given to the crop. It is most desirable that this should *not* be of stable manure, which it is very possible may contain Eelworms, but rather of guano and superphosphate. Carrots and Potatoes succeed best in the late-ploughed land. Should notwithstanding the worm-disease appear again at the same places in the fields, the spots should be dug anew deeply, two spades deep; we can also prevent the spread of these wormlets by isolating, by means of a trench of a foot and a half deep and a foot across."—J. K.

With regard to different methods in which the wormlet infection may be spread, it is shown by Dr. Kuhn that one way is in earth from infested fields. This is shown by an instance in which a man, to mark his disbelief in the possibility of such transmission, had earth from Eelworm-infected land spread on what was clean before, and thus set up attack. It is also noted that the infection may be spread in earth *carried* from infested land (that is, by earth adhering to agricultural implements, to the hoofs of horses employed on the foul land, or to the shoes of the agricultural labourers).

The danger of transmission in manure is most particularly noticed by Dr. Kuhn. He mentions :— "It is to be observed that the *Anguillula* can make their way in short haulm to the spindling ear. These worm-infested plants, which are cut with the scythe, later on

* *Centaurea cyanus*.

go into the manure. Such manure, found to be of straw-litter from wormlet-sick fields, *ought not to be carried* to fields which may still be free from disease. We can thus at least ward off new infection from the fields. It is only on very heavy land that such manure may be applied without consideration, because here the wormlets cannot cause important injury on account of the physical nature of the soil being unfavourable to their spread."—J. K.

(This matter of transportation in manure is very important, and, though I cannot here give at length Dr. Kuhn's various very practical cautions, the above examples warn us as to possibility of bringing in infection in Clover and other crops besides Oats, and likewise some in weeds. The Corn Bluebottle is named as a very fertile source of infection, and wild grasses as open to suspicion.) Dr. Kuhn concludes his valuable pamphlet with this summary:—

"Deep cultivation, rich manure, but with care not to use wormlet-infested stable-manure, and suitable rotation of crop, are the best methods for combating this evil; their application consistently carried out will be certain to succeed in time."

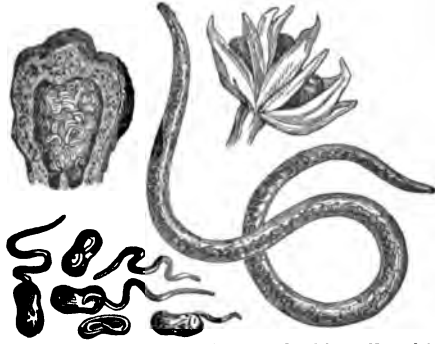
(The above information is taken from Dr. Jul. Kuhn's Monograph on 'The Worm-sickness of Rye,' and mainly from the two last pages.)*

The above extracts show the extraordinary length of time to which the Eelworms can live; the ease with which they may be carried in infested earth; the certainty with which they may be carried in manure made with infested straw, or into which infested plants, whether crops or weeds, have entered; the importance of rotation of crops, and also (as it appears some kinds of crops have not been known to be infested) the importance of saving all present trouble by putting an Eelworm-proof crop into infested land; the serviceableness of deep ploughing and digging so as to turn the pests down to a depth from which they *cannot* come up again; the serviceableness also of good measures of cultivation to push on growth, and of good firm land in which the wormlets *cannot* travel; and, lastly, we learn that in seeking the cause of presence of the disease we may have to go back several years for the reason of the original infestation.

Through the kind assistance afforded me I shall hope to be able to add further information as to the exact species of Eelworm now doing us so much injury.

* The name in full of Dr. Kuhn's work is 'Ueber die Wurmkrankheit des Roggens, und über die ueberunstimmung der Anguillulen des Roggens, mit denen der Weberkarde,' von Dr. Jul. Kuhn. Halle, 1869.

Wheat-ear Cockles ; Eelworms. *Tylenchus tritici*, Bastian ;
Vibrio tritici, Curtis.



Wormlets escaping from eggs; section of Cockle-gall, with wormlets within after Brauer's figs. (much magnified). Spikelet of Wheat, with galls (magnified). *T. tritici* wormlet (greatly magnified). Nat. length of largest one-seventh to one-fourth inch.

The purple galls sometimes found in great numbers taking the place of healthily-grown grain in ears of Wheat are caused (as well as the "Tulip-root" disease mentioned in the foregoing pages) by Eelworms. The above figure gives a general idea of the wormlets and of the eggs enormously magnified, and the latter may easily be known by being rather smaller in the middle than at the two ends.

At the end of August a bunch of Wheat-ears, almost ruined by the amount of Cockle-galls present, was sent by Mr. Price Jones, of Elm Green, Cirencester, who mentioned that he found presence of this Cockle-gall attack in Wheat in three fields covering together about twenty-seven acres. In one field, in a space of about two or three acres, the infested ears occurred rather frequently, perhaps two or three in a square yard. Over the rest of the ground they were far fewer, requiring some care to find them. It was remarked that this blight had not been noticed before by the farm-labourers.

Specimens of Cockle-gall in Wheat-ears were also forwarded on the 6th of October from Framlingham, in Suffolk, by the Rev. W. W. Tyler, with the mention that they had been brought to him as being rather common this autumn in several fields in the neighbourhood. Most of the Wheat-ears sent were very badly infested; in one which, by way of experiment, I rubbed out there did not appear to be any good grains, and the Cockles might be estimated at fifty or sixty. On splitting one of the galls and placing it in a drop of water the vast numbers of wormlets within (which were all collected together, as shown in the magnified section of a Wheat-grain figured) swelled up and overflowed in countless numbers on the microscope-slide.

These wormlets are male and female, and multiply by laying eggs. As their history was given in my last year's Report, from Dr. Charlton Bastian's valuable Monograph, there is no reason to repeat it now; but the method by which attack has been found to be set on foot is of considerable interest, both with regard to the Wheat-cockle, which it refers to, and also with regard to "Tulip-root" disease. "When the infested galls are sown together with healthy seeds the young in a week or so, according to the degree of moisture of the soil, make their way out of the softened gall, and, diffusing themselves in all directions, some come at last into contact with the budding plant just sprouting from the healthy seed, and then insert themselves between the sheaths of its leaves, gradually working their way round till they come to the innermost of these, where they remain for a variable time without increasing much in size till the rudiment of the future ear begins to form." . . . *

As the Ear-cockle worms appear to live in the galls in the Wheat-ear, excepting during the time when they are transferring themselves from the "Cockles" which have been sown with the seed to the sprouting plant, where they establish themselves as soon as possible in the embryo ear, it is evident that repetition of the attack may be prevented by being careful not to sow grain infested by "Cockles." They are easily distinguishable by their purple colour, and suspected grain may be tested by throwing some handfuls into water. I have not found in my own experiment that there was a single "Cockle" which did not float, whilst the good grain sank to the bottom.

Sulphate of copper steep has been suggested as a remedy, but the mere placing the grain in water without any chemical admixture, and skimming off the "Cockles" as they floated, would be a simple way of getting rid of the infection.

Wheat-bulb Fly. (? *Hylemia coarctata*, Fallen.)

The following communications refer to injury to young Wheat occurring to a serious extent after summer fallow or Swedes, and apparently caused by the maggot of a small two-winged fly.

Early in May I received specimens of infested Wheat-plant from Major Salmon, of Tockington Manor, Almondsbury, Gloucestershire, requesting information regarding the attack, as "large fields of Wheat have been seriously affected by the action (as he supposes) of the insect which will be found attached to the plants enclosed."

* "Mon. on the Anguillulidæ," by Dr. Charlton Bastian, 'Trans. of Linn. Soc., vol. xxv.

The specimens enclosed were maggots of some kind of small two-winged fly, of pale yellow or whitish colour, up to a quarter of an inch in length, smaller towards the head-end, which was furnished with strong black or dark brown mouth-hooks, and truncate or roundedly truncate at the tail.

The infested corn was injured by the maggots eating within and gnawing out the inner part of the shoots just above the bulb, and for some little way above. A small hole or slight tear was observable in some instances, this very possibly showing the spot where the maggot had made its way out when travelling.

In reply to further enquiries Major Salmon favoured me with the following details, which I give at length, as similar attack is reported every year, and at present we have not got information enough to enable us to deal with it:—

“ 1. The soil is marl, one of the last pieces of rising ground where the limestone hills fall down to the level of the low levels which extend from here to the Severn; just above where the pasture-lands of the level proper begin.

“ 2. Date of sowing of the Wheat, last November.

“ 3. Manure: a rather heavy dose of farmyard manure was given to the land before the crop that preceded the Wheat.

“ 4. Course of cultivation where this Wheat grows was, in 1883, fallow; 1884, Wheat; 1885, part Swedes, part Mangolds, part Vetches, part Potatoes; for the field is a large one.

“ It is remarkable that these maggots are not to be found in any part of this field, except where Swedes were grown last year; and that the maggots are incomparably more numerous and destructive in those parts of the Swedes where the Swedes *failed* last year. Where the Swedes were the worst the Wheat-plant is the most affected; and where there were other crops than Swedes last year the maggot is hardly to be found.

“ It is also to be remarked that the tops of the ridges (*i. e.*, where the soil is the hollowest from the plough having thrown up the two ridges together from opposite directions) are more affected than the ridges below these or in the bottoms. . . . The maggot seems new to the neighbourhood, but I have just heard that another of my tenants has found a few in some Wheat of his on land where he also had Swedes last year.”

The following note sent from Croft Wainfleet, Lincolnshire, on May 7th, by Mr. John Searley, refers to similar attack:—“ I enclose a sample of Wheat-stems eaten into by a small white worm. Wheat on land summer fallowed last year has suffered most in this district, where the soil is clay and mixed clay and sand reclaimed from the sea.”

On May 28th Mr. Searley furnished me with the details of tillage and succession of crops on the infested ground as follows:—"I have seen other summer fallow wheats fail this spring, but none of my neighbours have seen the grub. I will give the main tillage operations in field attacked.

"1884.—Wheat a good crop, but weedy; many common thistles. Ploughed in winter six inches.

"1885.—May, ploughed back.

"July, again ploughed and thoroughly dragged and harrowed to kill twitch. Left rough.

"August 4th and following days manured with well-trodden straw from bullocks eating cake in previous winter.

"Aug. 8th, ploughed and rolled.

"Aug. 10th, rolled and drilled with white mustard and 2 cwt. of mineral phosphate and bone-meal. Land was so dry that mustard did not come up until late in September. Little eatage (kept 100 sheep a fortnight on six acres).

Nov. 9th and 10th, ploughed and drilled with eight pecks of Main Stand-up White Wheat; seed not affected by this grub in previous year.

"1886.—Rolled in March; Wheat looking well for a sharp winter, —in fact, as well as rest of the farm. Wheat began to fail about April 10th. Grub not found until sent to you.

"Remaining eight acres of field tilled in same way in 1885, but sown with rape, which also failed, is *not at all* affected by grub.

"May 26th, many bare spots in Wheat, some roots which did seem dead sending up shoots after rain. Grub cannot be found."

The attacks above mentioned appear to be of just the same kind as those reported in 1881 and 1882,* but the only thing which seems clear as to any preceding points is that they usually occur after summer fallow, or after Swedes of which the crop has failed. In the report given above by Mr. Searley attack in one case was worst on land where there had been an unsatisfactory crop of Mustard eaten off by sheep.

In the instance in which the fly was reared from infested plants (in 1882) it proved to be a little greyish fly, somewhat like the Onion Fly in general appearance; and the following is its winter life-history, as given by Dr. E. L. Taschenberg from observations on attacked Rye injured by the two-winged fly, *Hylemia coarctata*:—

"I have only observed its method of life in the winter brood, for which the females laid their eggs in autumn in the winter-sown plant —in the last days of March I found the maggots in the heart of the

* See 'Reports on Injurious Insects for 1881,' pp. 18-20, and for 1882, pp. 20, 21, by Eleanor A. Ormerod.

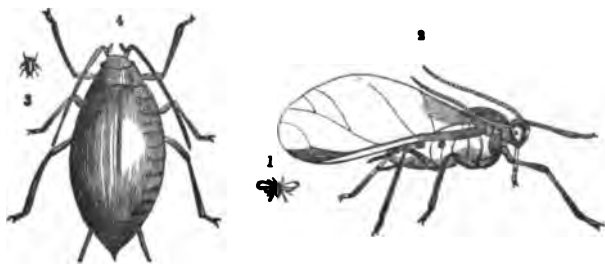
Rye-plants, the leaves were yellow at the tips, and gnawed and decayed at the root so that the heart-leaves could be drawn out. By the 25th of April some maggots were going into the earth to change to chrysalids, and by the 9th of May both chrysalids, and maggots nearly ready to change to chrysalids, were observable. From the 20th of May onwards the flies appeared in the early morning, at first only males, afterwards females; they appeared up to the 8th of June, and still some chrysalids remained."*

Dr. Taschenberg further observes "that this widely-distributed and common fly develops at least one more brood is evident, but how and where I have not yet made out; whether it may resemble the winter attack, only be in grasses allied to Wheat, or may come from manure, or where?"

This is what we still need to make out. It is plain, as previously remarked, that the fly that lays its eggs on the young Wheat sown after summer fallow cannot be the same fly that came out in June; but where the intermediate generation has fed in maggot condition, and changed to chrysalis and fly, is what we need to know before we can deal with this attack.

HOP.

Hop Aphis, and Damson-Hop Aphis. *Aphis (Phorodon) Humuli*, Schrank; and *Aphis (Phorodon) Humuli*, var. *Malaheb*, Fonsc.



APHIS (PHORODON) HUMULI.

Winged and wingless Hop Aphis; nat. size and mag.

The following observations are merely given to record the great amount of Hop Aphis which appeared late in the season, as it may prove of use to notice whether this is followed by absence or presence of Hop Lice and Fly next spring.

* 'Praktische Insekten kunde,' von Dr. E. L. Taschenberg, pt. iv., p. 120.

On Sept. 8th I received the following note from Mr. D. Turvill, of West Worldham, Alton, Hants, with regard to the serious injury caused to Hops (when the crop was almost ready for harvesting) by a great appearance of Aphides :—

“Here we are in the first week of the ingathering of this crop, and to our astonishment they are turning visibly before our eyes, red and redder every hour. The cause is not far to seek. There has been a late attack of Aphis, and immediately the cones develop themselves the larger Aphides (wingless females ?) forsake the foliage and enter them, and, by sucking the short stem of each seed-wing or scale, reduce it to a desiccated state that under the hot sunshine of the past few days becomes rapidly withered and brown. Also we may be engendering the progeny for a severe attack next spring, if the conditions of hybernation should be favourable.”

On Sept. 30th Mr. Mark Sandford, writing from the Pond, East Peckham, Tunbridge, Kent, mentioned the great appearance of Hop Aphis which had occurred in that district as follows :—

“Our Hop-picking is virtually finished here (a few days earlier than usual), and now our orchards and hedges are infested with myriads of Hop Fly. It is generally supposed that they are the parents of a heavy attack of Aphis next spring; the Damson trees are full of them.” The Damsons were also reported as being in some cases so covered with “lice” that they were almost worthless.

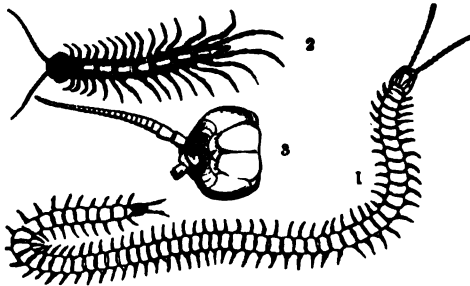
On Sept. 29th a packet of Hops injured by Aphides and black mould was forwarded to me from near Hereford.

It cannot, I think, be out of place, relatively to the fear expressed of early attack, to refer to the Stoke Edith experiments of 1884, in which it was found that in the instances of Hop-hills dressed in April with paraffin mixed with ashes, sawdust, or shoddy, the plants remained perfectly free from infection and perfectly clean up to May 26th (when attack came on the wing), whereas those in other parts of the Hop-yard were infested with wingless females and lice. The application did no harm either to the young bines pushing up through it, nor to the health of the plants; they did well throughout the summer.

If there is likely to be a bad attack in spring from the Hop Aphides that have wintered in the hills, or have hatched from eggs anywhere about the stocks, it certainly would save much loss if the amount of attack caused by lice creeping up the young bines from the hills early in the growth of the Hop could be prevented. The amount that arises afterwards towards the end of May or beginning of June from Hop Fly that comes on the wing cannot be prevented by the above measures, but it is lessened in the proportion of what in common circumstances would have spread from the bines which (where dressed as above) have

not been found to suffer from the first attack of Aphis, and therefore not to spread it. The proportion of paraffin used for the dressing was one quart, to one bushel of ashes or other dry material with which it was mixed.—(See pp. 52, 58 of 'Report on Injurious Insects,' by E. A. Ormerod. Simpkin & Marshall).

Long-horned Centipedes. *Geophilus longicornis*, Leach (? *Scolopendra electrica*, Linn.), (? *Geophilus subterraneus* of Murray's *Aptera*).



GEOPHILUS LONGICORNIS.

1, *Geophilus longicornis*; 2, *Lithobius forficatus*, "Thirty-foot"; 3, head of ditto, magnified.

There is no doubt as to the great mischief which is caused by the various kinds of millepedes, commonly known as Julius Worms or False Wireworms, but there are different opinions as to whether the long yellow centipedes (figured above at 1, greatly magnified) do harm or not. They are often to be found under stems, or pieces of wood, in gardens, and are distinguishable at a glance by their ochrey colour, the multitude of legs, and their habit of twisting in every direction when disturbed. When full-grown they are about two inches long, and the kind known as the Long-horned Centipede, which differs little, if at all, from the *S. electrica*, has the power of exuding matter which gives a bright light much like that of the glow-worm in colour, but which can be freely dropped from the animal. I have seen it as a trace or in bright spots on paper in which one of the centipedes had been carried.

In regard to the food of these centipedes, Mr. A. Murray considered them to be only animal feeders. John Curtis mentions them as being animal feeders, but also that he had found them amongst Potatoes; and, further, that they subsist partly on succulent roots, ripe fruit, and decaying vegetable matter, only coming out at night, apparently in search of food (see Curtis's 'Farm Insects.'). Dr. E. L. Taschenberg notes that they are to be found "at the roots and

bulbs of various plants, as of Potatoes, Parsnips, Carrots," &c. ; and that, according to Kirby's observations, they have been found destructive to the last-mentioned of the above roots.

The following notes sent me on the 20th of July by Mr. T. A. Ashton, of Temple Laugherne, Worcester, appear to point very strongly to the damage to his Hop-plant being caused by these centipedes, of which specimens were forwarded. It will be observed that the centipedes were found close to where the bine was gnawed, and where it was then fading ; likewise that after the centipedes were driven away from the surface of the ground by wet that less damage occurred.

On July 20th Mr. Ashton mentioned that they had been making considerable havoc in his Hop-yard during the summer. They were only found in the old yards, and only in places there,—not generally distributed. The bine was gnawed off close to the crown, and the centipedes were found under the soil round the head of the stock, and in some instances in cracks in the stock itself. In no case were any of the centipedes to be found where the stock had been dead some time, as shown by the condition of the bine ; all the specimens forwarded were found where the bine was fading, but not yet dead.

It was also mentioned that the places in the yards where the centipedes were all found were limited to where the Hops had suffered from wet. After the rain had fallen (July 18th) the centipedes went lower down in the ground, and less damage occurred.

I suggested that dressing the surface of the hills with ashes and paraffin might be of service, as being obnoxious to the centipedes,—and an application known by experiment on a good scale not to be injurious to the Hop-bine,—or that an application of "emulsion," as it is called in the United States (that is, of soft-soap and a little paraffin), applied as a watering, might be similarly useful ; but Mr. Ashton did not think his own experience of mineral oil as a preventive satisfactory.

The following observations of Mr. Martin Burl, of Elsenham, Bishops Stortford, refer to damage to Vetches or Tares infested by some amount of true Wireworms, but also by a much larger amount of the *Geophilus*, mentioned above. On the 28th of April Mr. Martin Burl wrote as follows :—

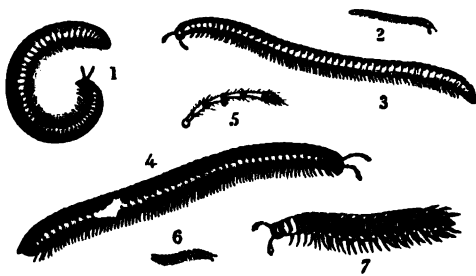
"Herewith I enclose specimens of insects, and would be glad to know if they would be the cause of my Vetches or Tares dying off, some few of which I also enclose ; they were sown in the autumn and came up very well, but have been losing plant the last two months ; and I am going to resow some three acres out of five, which is the extent of field. On digging over a piece to-day I find a very few of the ordinary wireworm, but a great number of the enclosed ('thousand legs,' as we should call them)."

A few days later some more specimens were forwarded, with a note that the millepedes (that is, the *Geophilus*) were by far the most numerous, and the following communication:—"I gave the field a dressing of 1 cwt. per acre of sulphate of ammonia about a month since, and have resown it with Tares to-day; it was cropped with Oats last year, and a good deal of long stubble was ploughed in, but no farmyard manure was applied."

Looking at the above observations, together with the notes previously given of the method of feeding of this kind of centipede, it does not seem open to doubt that they have a power of injuring crops, but at the same time they do not appear to exercise it often to a serious amount.

The history of long yellow *G. longicornis*, as given by Mr. Newport,* is that the female lays from thirty to forty eggs "in a little packet" in a cell which she forms for them in the earth, and does not leave them until the eggs hatch, which is in about a fortnight or three weeks. It is stated that during this time she remains in the cell with the eggs, incubating them, and constantly turning and attending to them.

From the above points it would appear that, where there is any great amount of centipedes, thorough stirring and turning the surface of the ground would be the best way to put an end to the attack, as they would thus be thrown out of their shelters in winter, and in the breeding season, when it is accepted as a fact that the female takes the enormous care mentioned above of the eggs, any operation which would scatter them abroad, where no shelter was given and no care taken, would save much increase.



JULIDÆ; POLYDESMUS.

1, *Julus Londinensis*; 3, *J. guttatus* (*pulchellus*, Leach); 4, *J. terrestris*; 5, horn; 7, *Polydesmus complanatus*; all magnified; and 2, *J. guttatus*; 6, *P. complanatus*, nat. size.

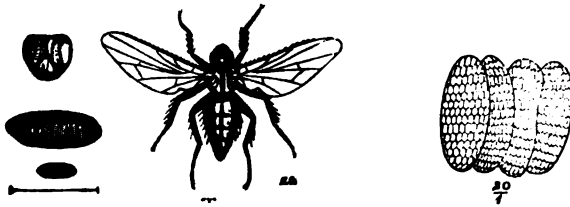
Snake Millepedes, or *Julidæ*, have again been noted as destructive, and in cases (such as one of those reported) where they are working

* Trans. Linn. Soc., vol. xix., p. 428.

havoc in very large country gardens, where the extent of ground allows a great deal of what may be called spare land, it is very difficult to remedy the evil. Where there is storage of decaying leaves, and all the miscellaneous matters which pass under the name of rubbish, on outlying bits of garden, there equally surely is a head-quarters for multiplication of millepedes, and a centre whence they will spread at leisure, as well as pass by carriage in compost to the neighbouring ground. For history and prevention see previous Reports.

MANGOLD.

Mangold Fly. *Anthomyia betæ*, Curtis.



ANTHOMYIA BETÆ.

Mangold Fly and pupa, mag. and nat. size; head and eggs, magnified.

The following note was sent me by Mr. John Page, of Yieldingtree, near Stourbridge, regarding a stimulating dressing which he had found useful in bringing Mangolds which were attacked by leaf-maggot satisfactorily through attack.

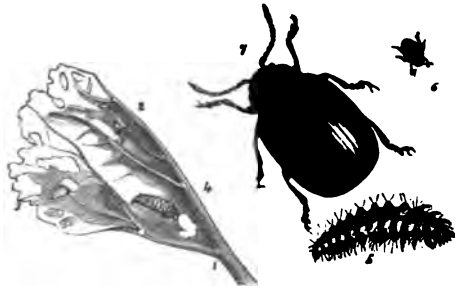
Mr. Page had forwarded me specimens of Mangold-leaves injured by the maggot, together with enquiries as ' what treatment might be serviceable; and on Aug. 18th he reported further:—

" Referring to the attack of Mangold maggot, I am happy to say it passed off without materially injuring the crop. I applied a dressing of 1 cwt. of nitrate of soda, 8 cwt. salt, 2 cwt. kainite and soot, per acre, which forced the plants into active growth, and they are now a splendid crop."

In attacks of this kind, where the crop perishes simply from exhaustion in consequence of the leafage being destroyed by the maggots faster than the growing powers of the plants can replace it, a dressing like the above, which will come into action with the first shower and cause immediate growth, is sure to be of use.

MUSTARD.

Mustard Beetles. *Phædon betulæ*, Linn.; Turnip Flea-beetle, *Haltica* (*Phyllotreta*) *undulata*, Kuts.; Turnip-flower Beetle, *Meligethes æneus*, Fab.; and Turnip-seed Weevil, *Ceutorhynchus assimilis*, Payk.



MUSTARD BEETLE.

Mustard Beetle and maggot, nat. size and magnified.

The replies with which I have been favoured by some of our leading Mustard growers to the circulars issued by the Royal Agricultural Society, requesting observations regarding the habits of the Mustard Beetle, and measures found useful for prevention of its ravages, contain much serviceable information, especially as to the great variety of places in which the Mustard Beetles, which start the spring attack, spend the preceding winter, and also as to means of lessening amount of attack (and amount of injury from what may occur) by regular agricultural treatment.

Also, by means of specimens with which I have been favoured we have been enabled to make out clearly which of the various maggots that are to be found on the Mustard-plant is that of the true Mustard Beetle, and thus to trace its history with certainty, which, as far as I am aware, had not previously been done.

Further, the fact has been very clearly brought to light that the mischief ascribed to what is commonly known as the Mustard Beetle is by no means entirely caused by this one kind. It is largely shared, when the plant is in its first leaves, by the Turnip Flea-beetle or Fly, and next, when the plant is knotting for flower, by the Turnip-flower Beetle, or *Meligethes æneus*. Other kinds of beetles are also present, as the small dark grey Turnip-seed Weevil (the *Ceutorhynchus assimilis*), and do more or less damage; but the two sorts first mentioned are present frequently and to a serious extent, and the *Meligethes*, which are not at all unlike the true Mustard Beetle, excepting in being

smaller and of a duller or more blackish green, are often mistaken for it.

These points are of use practically, as they place some of the methods by which the Mustard crop is to be saved from injury on quite a new footing. Turnip Flea-beetle at least can be kept down by methods of cultivation and treatment which are well known, and applicable to Mustard as well as to Turnips, and thus the complete ruin of whole fields of Mustard in its first growth might be prevented. We have no knowledge, as yet, of how to destroy *Meligethes* when on the flowering heads; but the fact that this beetle also infests the flower-heads of Turnip, Rape, and Cabbage, and likewise of Charlock, may be turned to account, both in rotation of crops and likewise in care to exterminate weeds which would foster it.

In the following report I have first given the replies with which I have been favoured relating to the habits and means of prevention of ravage of the Mustard Beetle, which was the special subject of enquiry, and to these I have appended the life-histories and descriptions, with figures accompanying, of the four kinds of beetles mentioned above, of which three kinds infest the plant to a serious extent, and the fourth is found on it, and, judging by its habits on allied crops, probably injures the formed seed.*

Where attack comes from.

- 1.—Where do the beetles which start the spring attack shelter in the winter? As—down old Mustard-straw; in straw used for rough thatch, &c.; down pipes of reeds; or in rubbish generally? Also—are beetles brought in seed?

The following observations show that the beetles shelter for the winter in a great variety of localities, as crannies in walls, gate-posts, or old wood; under bark, in the earth of hedge-banks, and of drain-banks; in heaps of rubbish; amongst rough grass by marsh-ditches, and amongst reeds, and down the pipes of reeds. Also in the ends of the Mustard-stocks, and in the roots of the old Mustard-plants left on the land, and in rough shelters made of Mustard or other straw; and it is noted that, when sheltered in the Mustard-roots or stalks, or pipes of reeds, they appear to be quite uninjured by exposure to frost throughout the winter.—ED.

“The beetles lie dormant in the winter in Mustard-stalks and reeds, and in all kinds of rubbish, and sometimes in the crevices of old woods.”—ALFRED FULLER.

* As it is necessary, in order to keep the series of subjects unbroken, to distribute the various portions of the contributors' reports under the headings of the enquiries to which each paragraph is a reply, I have appended the name of the sender to each of the communications, and likewise given it in the list of contributors.

"They shelter in the crevices of gate-posts, farm-buildings, &c., in the rough grass which grows on the edges of marsh-ditches, and in haulm walls, whether made of Mustard or any other straw. I found a great many last winter in the root-ends of the Mustard-stubble, a good part of which is left on the land when the crop is cleared, and may be found lying on the top all the following winter in the young Wheat. I have found as many as twelve beetles in one of these roots; they seem quite indifferent to frost, for, though when you open the stalk they seem dead, they soon begin to move. Many in these stalks, lying on the top of the land, must have been exposed to all the frosts of last winter."—ERNEST SMITH.

"I have found them in drain-banks, when digging during the sharp frost; also in crevices or cracks in a gate-post."—RICHARD H. SEARS.

"If the spring is warm they generally come in the beginning of May, or rather beetles then begin to attack the Mustard-plant, but probably not the *Phædon betula*. There are several kinds of insects which do great injury to Mustard during the different stages of its growth, up to the time it gets into flower. After the flowering-time the ravages of the *Phædon betula* are become more perceptible. There is a difference of opinion as to how and where they pass the winter. They have been found between the bark and wood of old decayed trees, in the cracks of gates, posts, and rails, in dyke-banks, hedge-bottoms, among reeds, in heaps of rubbish, stalks, &c., when left on the land,—in anything that will hide them warm and dry. A correspondent writes he has found them in all the above places, and has seen them out when the sun has been warm in winter."—SAMUEL EGAN.

"I think the majority are to be found in the earth at the bottom of the hedgerows surrounding the field in which a crop of Brown Mustard has been grown."—WM. ABBOTT.

"I believe these beetles during the winter months get in any reeds by the side of ditches, but what they feed on until spring I cannot say; but at the spring you may find them on any kind of Charlock or pieces of Mustard that are growing anywhere about."—JOHN TIBBETTS.

"This insect will live through the most severe winter in the pipe of the reeds and rushes in ditches and drains. Two or three years since they were so numerous that many acres of nearly-ripe seed were burnt in the fields to destroy the beetle, but this was not effective, as they drop before the flame and bury themselves in the soil."—C. CASWELL, Peterborough, 1888.

"In the ends of old stocks which are left on the land after the stocks are raked up and burnt; also on the ditch-banks in the long

grass or in the earth, they will live in the seed till the spring."—CHARLES CLAY HARVEY.

ARE BEETLES BROUGHT IN SEED ?

The replies mention that they are to be found in seed after threshing, and have been seen alive in seed two years after threshing, but have rarely been observed to be brought with the seed.—ED.

"They are frequently found in the seed when freshly threshed, but do not appear to remain long afterwards."—ALFRED FULLER.

"I do not think they are brought in seed."—RICHARD H. SEARS.

"They are rarely brought with the seed."—SAMUEL EGAN.

"I have no personal knowledge that they are brought with the seed. I should think careful sifting in a close sieve would prevent their being sown with the seed, or I should think that the ordinary solution of vitriol, which is used for dressing seed-wheat, would kill them."—ERNEST SMITH.

"I have never seen beetles in the seed, nor do I think they are brought there even the shape of eggs."—WM. ABBOTT.

"We have found the beetles alive in sacks of the seed for two years after it has been threshed."—C. CASWELL.

Weeds and Crops attacked.

2.—Upon what weeds or crops do the beetles feed till the Mustard is ready for them ? As—Charlock, and the like ; or brook-lime, and other weeds found by ditches ?

"Cress, Charlock, Kohl Rabi, Cabbage, and other things of same nature and constitution."—ALFRED FULLER.

"My opinion is that they will eat White Mustard before anything else, then garden Cabbage and Horse-radish. Although there is abundance of Brown Mustard and Charlock growing near where the beetles were very numerous last year, I have only seen one or two on these plants at present."—ERNEST SMITH (June 26th, 1886).

* "I am not aware of any plant they feed on earlier than the Mustard. Charlock comes about the same time as early-sown seed. We have had Mustard growing, or at least green, all through mild winters, but we have not seen it eaten by beetles before the spring—April or May. Beetles appear as soon as the Mustard gets in leaf : the first have two light drab stripes down the body ; others follow. It is the beetles which do the mischief : there are no grubs early in the season perceptible to the naked eye. In the beginning of May they

* This note refers to appearance of beetles generally (that is, not only of the *Phædon betulæ*) on Mustard. The striped beetles referred to are Turnip Flea-beetles, of which the attacks to Mustard are sometimes very severe.

will attack the leaf when old and strong (flavoured), then the stalk, working up to the pods (these they bark, the seed dries up, and drops worthless).”—SAMUEL EGAN.

“They appear to feed on all strong-tasted plants. For the last week they have been crawling out of my marsh of Mustard, have got into my garden (which joins it), and are now feeding off my Broccoli, and other species of the Cabbage; also Horse-radish, Nasturtiums, &c.”—C. C. HARVEY.

Means of preventing Attack, or of lessening the amount by Agricultural Measures.

8.—Dates of sowing; methods of cultivation and of preparation of the land found to answer in pushing the plant-growth on past harm from common amount of attack?

The following notes refer chiefly to the dates of sowing found to answer best in various localities and circumstances; to soil suitable for Mustard growing, and to details of thorough cultivation; liberal manuring; and other points adapted to favour healthy and free growth:—

“In Cambridgeshire, February to March; in Lincolnshire, March to April. I have this year sown some as an experiment in May, and it is going on well; but I prefer March sowings. The land should be in very good heart (newly broken-up land is undoubtedly best); it should be well-manured in the winter, well-worked and rolled down until solid before the seed is drilled, and again rolled after the drill. The seed should be drilled with superphosphate—if with a water-drill, so much the better.”—WM. ABBOTT.

“We generally sow Mustard from the 5th to the 15th of March, on land which was fallowed all the previous summer, and plentifully manured. By the end of March, in a fairly growing season, the young plants have stems as large as that of a clay-pipe; they are then singled out, allowing about a foot or fifteen inches between each. In the two years that I have known the beetle it has not begun to attack the plant before this time.”—ERNEST SMITH.

* “First week in March on summer fallow, well-mucked and scarified, and harrowed in.”—C. E. HARVEY.

“But my opinion in growing Mustard-seed is to put it in the ground as early in the spring as one dare for it not to be hurt from frost (say the latter part of February or beginning of March), and then the seed gets too forward before the beetle lays the eggs and becomes the maggot.”—JOHN TIBBETTS.

“We sow Mustard from March 20th to April 6th. If sown too early it is the more liable to injury from insects and frosts. Make the

* Mr. Harvey's note refers to White Mustard.—ED.

land firm by rolling, deposit the seed just below the surface ; it comes up sooner."—SAMUEL EGAN.

" This year I have sown Mustard as early as the 2nd of April, on a nice fine loamy soil : it came up well, and grew very rapidly. When about 15 to 18 inches high it began knotting for flower (a farmer's expression), I noticed the heads smothered with tiny beetles* (the Mustard Beetle). I should have sown about twenty bushels of soot per acre if I had had it by me, but on the 1st of June we had a very heavy thunderstorm, with some hail, after which I did not notice many beetles. It is now a fine piece of Mustard, nearly fit to cut, although the tops of the stalks for about 8 to 5 in. have no seed-pods on. I sowed 2½ cwt. superphosphate of lime per acre, drilled with the seed."—RICHARD H. SEARS.

" The soil upon which Mustard is sown is the black peat or fen, which produce very fine crops when not injured by beetles. The early crops (sown, say, late in March or early in April) are generally best, but no manure or preparation of the land appears to have any effect upon the ravages of beetles."—ALFRED FULLER.

On application to Mr. Jaques, of Howden, to whom I had been especially referred as a successful Mustard-grower, he mentioned that, although he had been a Mustard-grower for several years, he had hitherto escaped any attack from the Mustard Beetle, and favoured me, on further request, with the following details:—

" The soil is known as 'warp,' and is artificially made by conveying the muddy waters of the Humber (and securing the alluvial deposit) on the original surface. I have latterly grown about forty acres per annum, about half of which was summer fallowed in the previous year, and dressed with farmyard manure in the ordinary way. The other half has usually been taken after Wheat on land in good manurial condition (this year, for instance, on land that was Clover and grass for seven years, then Potatoes 1884, and Wheat 1885 ; both crops heavy). As soon as the Wheat last year was harvested the land was twice steam cultivated ; then left until February, when it was ploughed over ; then left until the middle of April, when it was well-harrowed and drilled 16 in. apart with about 6 lbs. of White Mustard seed per acre. It is now coming into flower, and looking very well for so ungenial a season. When I have thought it necessary I have drilled 4 to 5 cwt. superphosphate or dissolved bones to push on the plant in its early stages. This year the weather and the soil were so cold in these parts that the plant germinated slowly, and made little progress for some time afterwards. Considerable breadths, I hear,

* The beetles sent accompanying were specimens of *Meligethes aeneus*, the Turnip-flower Beetle, of which account is given separately.

were ploughed up and resown in Holderness. Whether this was owing to the low temperature or the beetle I do not know."—THOMAS G. JACQUES (June 15th, 1886).

"I will just go over the best method for producing a crop of White Mustard-seed. First, make a clean *summer fallow*. Manure it with a large quantity of *unrotted* farmyard or stable manure: set it up in *four-yard* lands: plough in deeply: water-furrow and grip the field, as though for Wheat: leave it until the spring frosts are *well over* and the land dry enough to carry the horses without treading. Then harrow with sharp-tined light harrows. The fine winter mould gives an excellent seed-bed. Drill in the seed,—clean bright seed,—not too deep (say one inch only): cover with seed-harrows, without rolling. Four pounds of good seed should be sufficient, if it is a satisfactory tilth. If Charlock or other objectionable weeds should appear, it will be well to clean them out with the hoe: if the plants are too thick, set them out with a four-inch hoe. Cut with a self-binder. Stack in wide stacks on account of linnets, or thatch down the sides. Thrash in March, when the days and nights are equal. And, if you have managed your apparatus satisfactorily, and have been fortunate in the season, you may send into the barn *five* quarters per acre,—five is possible,—I have thrashed *four and a-half*."—RALPH LOWE.

"I do not see my way to any efficacious remedy or preventive. I believe that early sowing and likewise manuring give the plants the best chance of escaping serious damage; but nothing can save a crop of White Mustard where once it is attacked after the seed-vessels are formed and before the seed is fully ripe."—W. C. LITTLE.

The following observations refer mainly to checking attack in infested districts by discontinuance of growth of Mustard for a time, and thus fairly starving out the beetle:—

"The only thing to be done when a farm becomes infested with the pest is to discontinue the growth of Mustard for a few years. This has been found to answer. Though the insects can live on other plants, they certainly diminish in numbers, and almost entirely disappear in the course of two or three years if there is no Mustard in the immediate neighbourhood. Burning the straw and chaff is, I think, desirable whenever the insects are numerous. You see I have spoken of the beetles as if these were only one kind of insect-enemy, but I have no doubt you are right in charging the Turnip Flea-beetles, and also the flower-beetles. Still, *the* beetle, *Phadon betulae*, is the arch enemy, I think."—WILLIAM C. LITTLE.

"I have not heard of any effectual remedy. I tried to kill the beetles when the plants were not very high by rolling and cross-killing, but they did not mind it in the least. I also had men to go

in amongst the crop with tin mugs to shake every stem on which a beetle was seen, and so catch them. This was very expensive and unsatisfactory. I believe the only remedy is to leave off growing the Mustard a year or two, and so starve it out. If the beetle will really take Brown Mustard as a substitute for White, it will be difficult to do this in a neighbourhood like ours, where large quantities of Brown Mustard grow spontaneously."—ERNEST SMITH.

"As at present informed, I do not think there is any preventive but to leave off growing Mustard for a time. . . . Some few years back it used to be grown rather largely in this neighbourhood, but through the ravages of the beetle it could not be profitable; but this last year or so it has been grown again, and the beetles have not damaged it to a great extent."—WM. WILES GREEN.

"We have grown White Mustard for many years, but, through the entire destruction of the crop from the ravages of the Mustard Beetle, were obliged to discontinue it for some years."—RICHARD H. SEARS.

"The idea prevailing amongst those who have suffered very much from the ravages of the beetle is that nothing will destroy them, excepting it is the combined action of farmers not to grow any kind of food suitable for them."—ALFRED FULLER.

4.—What manures have been found serviceable? Is gas-lime used? Superphosphate of lime and artificial manures advised. Gas-lime not found to keep off attack.

"I have used Proctor and Ryland's special Mustard manure very successfully, the object being to promote healthy and rapid growth out of the way of insects. Artificial manures are necessary to secure a crop on old broken-up land. I was shown a crop the other day on part of which none was used, owing to a heavy dressing of farmyard manure having been applied. This was not half the value of the rest of the field."—SAMUEL EGAN.

"Besides superphosphate any rich manure is useful. I have not found gas-lime to be of much use."—WM. ABBOTT.

"Superphosphate of lime and dissolved bones have been found most serviceable. I have tried nitrate of soda without any good results. I am now applying gas-lime, but have not hitherto tried its effects." With regard to method of application it was noted:—

"The gas-lime was too adhesive to distribute evenly, so it was carefully mixed with sufficient fine dry ashes to make it powdery; it was then sown early in the morning, in the hope that it would adhere to the leaves, as it would appear to me to be of very little value if thrown upon the ground." (Further on Mr. Fuller mentioned):—

"I have been waiting to see how the Mustard Beetle developed before writing you again. This evening I have been to the field upon

which the gas-lime was distributed. There has not been a large quantity of beetle upon this field, but there will, I fear, be sufficient maggot to destroy the crop. Maggots alive and very voracious on fresh Mustard."—ALFRED FULLER, Esq., Ramsey, Huntingdonshire, July 10th, 1886.

Measures for Destroying Grubs or Beetles.

5.—Is there any kind of treatment found useful in getting rid of the grubs, such as dressing with lime or other applications when the dew is on? Or are any measures of service when the grubs go down into the soil for their change, such as hand- or horse-hoeing which would throw the chrysalids out, or lay them open to such birds as may eat them? Information would be particularly desirable as to any methods of destroying the beetles on the plants (if any such are known), or of checking progress when advancing in bodies. Notes as to checking progress by fire, or by making a trench in front of the advance and killing the beetles in it, or by any other means would be very acceptable.

The following observations refer to dressing *not* being found of service in getting rid of the grub. Ploughing in the crop at once when failing under beetle attack is noted as a means of saving further infection by burying down the eggs, which would otherwise have started a new brood, or by killing the insects which would have migrated elsewhere. In reply to the enquiry as to means of stopping the migration of the beetles in large bodies, observations are given of the practice of burning straw in front of the advance being often, though not always, serviceable, and of the use of tar filled along a shallow trench being also serviceable for the same purpose.—ED.

UNSERVICEABLENESS OF DRESSINGS; SERVICEABLENESS OF PLOUGHING IN CROPS INJURED PAST POWER OF RECOVERY.

"I do not know of any dressing that will stop the beetle when it has got to work."—W. ABBOTT.

"I have sifted over the plants, lime, soot, sulphur, and sprinkled Jey's fluid and rock-oil, but with no effect. I do not know any birds that will eat them, or any way to kill them."—C. C. HARVEY.

"Many things have been tried to destroy them or stop their ravages,—soot, salt, sulphur, lime, and carbolic acid,—and all without effect, so far as I am aware. The carbolic acid only killed about 10 per cent. of the beetles, although quite strong enough to kill the plants. . . . When the Mustard is dead, or ripe, the beetles leave it for other green crops; Rape, Turnip, or the like, they appear to leave in

a body; I have seen hundreds on a space but a few inches square. On one occasion they attacked a piece of Cole rather late in the season. The owner ploughed it up deep so far as he found beetles, and rolled it down with a heavy roller. By that means he says he saved his crop."—W. EGAN.

"Last year I had one marsh, which, about the second week in April, they commenced their attack upon in such quantities that they appeared to advance in a straight line and positively clear the ground as they went. The plant at this time was about four inches high. I saw that it was no good trying to save the crops, and on May 4th ploughed the marsh (29 acres) up and sowed it with Oats. I think this was the means of destroying an immense quantity of beetles, as all the under part of the leaves of the Mustard was covered with eggs, which, if the plant had been allowed to stand, would undoubtedly have been hatched out; when the leaves wilted the eggs perished."—ERNEST SMITH.

USE OF TAR.

"I have just made an unpleasant discovery that 89 acres of Turnip and Mangel are infested with the blue beetle, which appeared on my Mustard, disappeared, and suddenly reappeared on the Mangel; they seem to pass on to the Turnip after rapidly devouring these. We tried quicklime, dry lime, and Condry's fluid; but to no purpose. The headlands, roads, and footpaths are covered; there are millions. The Chase, leading to my house, is crawling; they travel from the Mustard field. Now the Mustard is cut they seem to have abandoned it for the opposite side of the Mangel and Turnip. I am working a shallow trench and filling it with cold tar, and I find they get in and cannot extricate themselves."—Per favour of MESSRS. CARTER & Co., Holborn.

NOTES AS TO CHECKING PROGRESS BY FIRE.

"I have heard of straw being burnt in front of their line of march when the wind lay right for blowing the smoke over them. By persevering, this plan has proved partially successful; they retreated before the heat and smoke."—SAMUEL EGAN.

"Some years ago I had a piece of Cole, or Rape-seed (sown in July), next to a White Mustard field. The beetles went over the ditch and cleared every particle of green Cole-seed, just as far as the Mustard field extended. I took two loads of short and damp straw and spread it in a line just before them (about 150 yards long), and set fire to it. It prevented them going any farther."—RICHARD H. SEARS.

"I have heard of the method of burning damp straw in dull heavy weather, when the smoke will keep low on the ground, the fire being arranged so that the wind takes the smoke in the right direction, *i. e.*, on to the plants."—WM. ABBOTT.

"Burning straw to cut off the beetles has been tried, but they burrow in the land and quickly reappear, and accumulate so rapidly that killing a few thousands is not noticed."—ALFRED FULLER.

"I do not know of any remedies, or rather preventive steps, being taken, except that sometimes when an army of beetles has been seen on its passage into or across a field of young Rape, Kohl Rabi, or some similar crop, stubble or straw has been burnt, and has been effectual."—WILLIAM C. LITTLE.

"From a Mustard field they troop off to any neighbouring field where plants of the same tribe are to be found. They will completely devour a field of Rape if it is in a young stage, and a crop of Kohl Rabi, with bulbs as big as an orange, may sometimes be seen with the leaves bitten off by these insects, nothing but the rib of the leaf being left. At this period they seem to make little use of their wings. I have stopped their progress completely by burning damp straw in a gateway through which they were passing, but previously they fly vigorously. No attempts appear to be made to check the pest, excepting the above plan of occasionally burning straw or stubble to arrest their progress when moving from one crop to another, or burning the straw or haulm after the crop has been reaped, by which means the great numbers of beetles which had sheltered in the hollow stems of the plant are destroyed."*—WILLIAM C. LITTLE, 1888.

DRAGGING WITH ELDER BOUGHS.

"Brushing with elder boughs fixed in a hurdle and drawn by a horse over the young plants is useful, as also is hoeing and rolling. These measures act as a check to the work of the beetles. Probably the birds destroy the chrysalids when drawn up by the hoe; young chickens and ducks, too, will eat the insects."—W. ABBOTT.

General Information.

6.—As to effects of weather; to the rotation of crops; to the neighbourhood of previously infested land; in fact as to any of the points which are known to Mustard growers as bearing on the subject, would all be of service. Any observations as to whether wireworm was found in Mustard fields, or attacked Wheat or other crops succeeding Mustard, would also be of much interest.

* This observation, with which I was favoured by Mr. W. C. Little in 1883, is particularly worth consideration, as it points out the possibility of destroying the migrating bodies whilst passing through a confined space; and likewise mentions burning the Mustard straw after the crop has been reaped. Where this is carried out, spring attack from the beetles which had wintered either in the stumps or the old roots, as mentioned at p. 59, would effectually be prevented.—ED.

"We grew several acres, 80 to 40, of White Mustard annually (before we were troubled with the beetle) up to about ten years ago. It then spoilt the crop completely, so that we left off growing. I have this year tried a piece again."—RICHARD H. SEARS.

"No doubt warm showery weather, from the time of drilling until the plants are in flower, is the best of all remedies against the attacks of the beetle. I have seen crops attacked growing miles from the nearest land whereon Mustard was grown the previous season. As to rotation of crops, I have found Mustard succeed well after Clover or even a straw crop, if a large dressing of manure has been applied on the stubbles; but I have had poor crops after Turnips eaten on the land."—WM. ABBOTT.

"It appears to me that the rotation of crops does not make much difference, unless you sow such crops as will provide food for the beetles. Whenever they appear in any part they quickly spread to the neighbourhood, going a long distance for suitable food."—ALFRED FULLER.

"I first recollect hearing of the ravages of the Mustard beetle in Lincolnshire about twenty-five or thirty years ago. A farmer spoke of them as the Mustard 'Clock,'—I will not be answerable for the correct spelling of the word,—a kind of beetle that injured the Mustard plant if grown more than two years consecutively on the same land or adjoining fields. I heard little more of them until a few years ago, when they made sad havoc in the fen districts of Cambridge-shire, Whittlesea, March, and Ely; they came in swarms, a perfect pest. When the Mustard was done they took the Cabbage and Turnip plants among the Mangels, completely destroying them. I have counted over 500 shaken from one Cabbage. That season they destroyed every crop of the kind in their track,—Turnips, Rape, Cabbage, and Mustard. We have suffered very little from them since; we have not many this year, at present. From observation I find there are certainly more than one kind of beetle which injure the Mustard plant. I have forwarded you at least three distinct kinds, I believe. Some seasons we scarcely hear of any injury being done by them. On pieces of land that have not been Mustard before or for some years we rarely find them; lands that have been Mustard two years or more invariably suffer most. The leaves enclosed are very much perforated; they came from near Long Sutton, in Lincolnshire, while in this neighbourhood we have heard of but little injury being done at present."—SAMUEL EGAN, Wyde House, Thorney, Peterborough, June 26, 1886.

"I have been in the habit of growing upwards of 100 acres of Mustard every year until this, when I have none at all; most of my neighbours have done the same. We are surprised that the

one bold man who is growing it this year, in close proximity to fields where the crop last year was almost spoiled by the beetle, has not had his entirely eaten up, and they do not seem to have harmed it at present. On Foulness Island, where last year there were 850 acres of seed there are now only 26 acres, and yet, strange to say, this small area is not much affected by the beetle; there are but a few specimens to be found in it, and they seem to have done no harm *at present*. In my opinion, at certain times they fly in large quantities with the wind; a field of seed may be free from beetles one day and covered with them the next."—ERNEST SMITH.

The following notes show sudden appearance of the beetle:—

"I was on Foulness yesterday, and Mr. C. C. Harvey showed me a roadway running alongside of the only (in consequence of the beetle) field of Mustard on the island. It was covered with beetles, which were leaving the Mustard in search of pastures new. *They only showed themselves ten days ago*, and in that time have done much damage. I enclose a few stalks to show their work. As soon as the stalks become hard, I imagine they leave it and go elsewhere. I am told they are spreading in other parts of Essex."—ARTHUR HARRINGTON.

"I left the neighbourhood where Mustard-seed is grown in 1872, when the beetle was not known; and hearing the damage it did last season, and knowing that a great many growers did not intend growing any more, I thought seed might be scarce and perhaps dear, so was tempted to sow 25 acres here, which is at least 10 miles from the nearest point of the mustard neighbourhood, and so thought I should be safe from the insect. I have been on the look-out for the beetle for weeks past, and on Wednesday last two or three made their appearance. I have now two men doing nothing else but collecting the beetles, which we put into bottles and scald every night. They collect on an average between 300 and 500 each per day, and I believe we shall be able to save the crop. My Mustard is now from 3 to 4 feet high."—W. M. MEESOM, Battles Bridge, Essex.

Wireworm.

7.—Whether wireworm is found in Mustard fields, or attacks Wheat, or other crops succeeding Mustard?

From the replies noted below it appears that Mustard is frequently of use in getting rid of wireworms in the land, or in lessening the amount of their ravages, but that it is not exempt from wireworm attack; and where wireworms are present in very great numbers that it may suffer as severely as other crops.

"I have not seen or heard of wireworms attacking succeeding crops of Wheat or other cereals,"—ALFRED FULLER,

"I believe it to be a good system on land infested with wireworm to grow White Mustard. In my experience on a certain piece of land several crops failed through wireworm ; we sowed White Mustard one year and got a good crop of Wheat the next."—RICHARD H. SEARS.

"Mustard is a very excellent preparation for Wheat, if not the best. Mustard has a tendency to destroy or prevent the ravages of the wireworm. A field well-known to the writer was infested with wireworm some years ago ; it has now been Mustard several times. Wireworms are rarely met with ; the Wheat crops lately have not suffered in the slightest degree."—SAMUEL EGAN.

"Mr. Tallant, of Raucby Grange, in 1827 introduced the practice of sowing White Mustard upon land infested with wireworm. It has been considered to be a specific from that time."—RALPH LOWE.

"I have not noticed wireworms in Mustard fields."—WM. ABBOTT.

"The wireworm seldom attacks any crops grown after Mustard, but does most mischief after Rye-grass, Tares, and sometimes Turnips and Mangolds ; but have noticed that there are certain lands on my farms which are continually eaten up by wireworm, the same spot in the same field, year after year."—THOMAS P. BRAND.

"I think it is a common thing to find Mustard attacked by wireworm, but only on land which is subject to the pest. I have had a marsh of Mustard destroyed by wireworm, and when ploughed and sown with Oats met the same fate."—ERNEST SMITH.

"In 1885 I had a piece of 4 acres of Potatoes very badly infested with wireworm, so much so as seriously to interfere with the quality and sale of the produce of the crop. *Mustard* not having been grown upon this field for very many years, and inclining to a somewhat popular belief that such crop acted as a scourge to the insect in question, I sowed the field (drilling broadcast) with one peck per acre of seed. Although well done, and the land in perfect tilth (8 cwts. per acre of guano harrowed in before sowing), the seed did not make its appearance ; and on examination I found that so soon as the germ showed signs of vitality the wireworm ate its way through it. Thus the chance of a Mustard crop was entirely destroyed. Certainly 95 per cent.* of the seed was thus consumed. I may add that samples of this Mustard were sown under other circumstances, and showed great growing capabilities.—A. BANNESTER.

* As confusion occasionally arises between presence of the true wireworm, and of millepedes or "false wireworms," which are also very injurious to Potatoes, I think it desirable to note that the observer is perfectly aware of the distinctions between the two kinds, and that the above observation refers certainly to the true wireworm (that is, to the larva of the click-beetle).—ED.

Descriptions and notes of various kinds of beetles injurious to the Mustard crop. *Phadon betula*, Linn.; Mustard Beetle (see fig., p. 58).

The beetle, which is especially known as the Mustard Beetle, is the *Phadon betula*, Linn., formerly the *Chrysomela betula* (see fig., natural size and magnified); it is oblong-oval, hardly the sixth of an inch in length, of a full blue or greenish colour above, so brightly shining as to be of almost glassy lustre. The leg, horns, and body beneath black. The thorax (or fore body) evenly punctured, the wing-cases with lines of punctures, and the spaces between these punctured also.

These beetles pass the winter in a torpid state, in any convenient shelter near the fields where they have been in autumn. In spring they become active again, and, spreading to whatever food-plant may be near, they lay their small eggs and die. The grubs which hatch from these eggs are of the shape figured, and are from about three-sixteenths to a quarter of an inch in length when full-grown; slightly hairy, of a smoky colour spotted with black, with black head and stout black conical horns, lighter at the base. They have three pairs of claw-feet and a caudal foot or proleg at the end of the tail, and along the sides of the body are a row of tubercles, from which the grubs have the power of protruding a yellow gland.*

These voracious grubs devour broadcast until, when full-fed, they go down into the ground to turn to chrysalids. In this state they are said to remain about fourteen days, and from these chrysalids the summer brood of beetles comes out, which often spreads devastation over the Mustard crop, which is then in an advanced state.

This is the history of the true Mustard Beetle, but the observations of the past season have shown that harm is caused to Mustard by various kinds of Turnip Flea-beetle, or Turnip Fly, as it is commonly called. The following observations refer to this attack:—

“The Turnip Fly is sometimes a great trouble by eating the plant when it first comes up.”—ERNEST SMITH.

“I send you another specimen of the pest, which I believe is the real cause of the mischief, for I have to-day ‘caught him in the act.’ . . . They are very difficult to catch, as they hop off the Mustard so very briskly, and the one in the quill is the only fellow I could get there. . . . I can find no Mustard Beetle in the field, and my belief is thereby strengthened that the ‘flea’ now sent is the cause of all the mischief. I enclose a little bit of the Mustard-leaf: scarcely a plant can be seen of the original sowing.”—W. ABBOTT.

The specimen sent was of one of the yellow-striped flea-beetles known as *Phyllotreta undulata*.

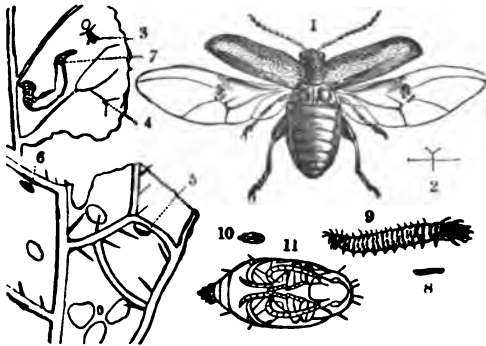
* The description given by John Curtis, in his ‘Farm Insects,’ of a larva which he considered would turn out to be that of the Mustard Beetle, precisely agrees with those from which I developed the beetle last summer.—ED.

"I send you specimens of insects which are now apparently destroying my Mustard on that part of the field where the seed-bed was not properly prepared; they are not to be found elsewhere."—R. C. CATLING.

[Three distinct kinds of the beetles, commonly known as Flea-beetles, were sent accompanying.—ED.] Eight days later (that is, on the 16th of May) it was further reported that the beetles had greatly disappeared, *owing to the deluges of rain which* had occurred, and previously to this a dressing of liquid superphosphate had been applied.

The Flea-beetles are easily distinguishable from Mustard beetles by their tremendous leaping powers, and often by having a yellow stripe along their dark green or blackish wing-cases.

The accompanying figure shows the enlarged thighs, suitable for leaping with, which are one chief mark of this family of beetles, and also gives a general idea of their shape.



HALTICA NEMORUM, Linn.

Turnip Flea-beetle, eggs, maggot, and pupa; nat. size and mag.

The *P. undulata*, which I found on Mustard, differs from the kind figured above in having the shanks reddish yellow only at the base, whereas the shanks of *nemorum* are entirely reddish yellow; but the two kinds are very like each other, and very common.

The habits of Turnip Fly, like those of Mustard Beetle, are to shelter during winter in any convenient place, and come out again in spring, and (as we know) attack the seed-leaves (and others, if tender) of Turnip, Cabbage, or allied plants; but Mustard is especially sought by it, as is shown by the practice in some places of mixing Mustard with Turnip seed to draw off the fly. The same methods of good cultivation and manuring, which are suitable for pushing on vigorous growth both of the Turnip and Mustard (and which are especially advised in the previous pages by good growers as a means of keeping it free of the Mustard Beetle), would be an important help against Flea-beetle; and a large part of the treatment advised by Turnip

growers in the Report of 1881 on this means of keeping down the pest would apply equally well to lessen its ravages on Mustard.*

Amongst the various details there given dusting the infested plants with lime or any mixture injurious to the beetles is particularly mentioned as serviceable, if applied when *the dew is on*, so that the beetles, having their leaping-legs clogged with the moisture, cannot get away, and the poisonous mixture adheres to them. Many sorts of mixtures will serve equally well, but as the following differs slightly in its ingredients from those previously mentioned, and the recipe was contributed during last season's Mustard observation, I insert it as follows :—

“To prevent the Turnip Beetle from destroying the Turnip seedlings, I find dusting them with a mixture of soot, lime, burnt soil and stick-ashes, or charcoal in dust, to be useful, with brimstone or petroleum to give it a strong smell. This to be used when the dew is on the seed-leaves, early in the morning or late at night after a shower will do. I have worked for hours, after the men have done work, spreading the dust with the hand, but have never had to regret it as lost time.”—J. W. FREEMAN.

Mr. Fisher Hobbs's mixture is still simpler, and has been well tried. This is one bushel of quicklime and one of gas-lime, six pounds of sulphur, and ten pounds of soot, mixed well and to a fine powder. This to be applied *when the dew is on*. The above amount is enough to dress two acres. The dressings may be applied by hand or by machine.



MELIGETHES XENEUS, Fab.

Beetle and maggot, magnified; and infested flower (after Dr. Taschenberg).
Jaws and antennæ of maggot, much magnified.—Ed.

Next after the flea-beetles on the young leaves come the “Turnip-flower Beetles,” figured above, on the heads knotting up to flower. Last season's observations showed that these little beetles (which are only of the length marked at the left of the magnified figure) occur in great numbers.

On June 10th Mr. G. Moore, Secretary of the Wisbech Chamber of Agriculture, forwarded me a box containing a large number of them,

* See Turnip Fly. Report of Observations in 1881. By E. A. Ormerod. Simpkin & Marshall, Stationers' Hall Court, London. Price 6d.

"now infesting a large field of Brown Mustard on the farm at Needham Hall" (near Wisbech); "I noticed them on Sunday evening in great numbers in the flower-knots of the plants, and I have during the past two or three days seen them in other fields on other farms."—G. MOORE.*

On June 14th specimens were sent, shaken off the flowers of Mustard-plants near Peterborough; on June 26th specimens were sent from Wainfleet, Lincolnshire; and on July 27th I had again some of the same kind of beetle (*M. æneus*) sent on flowers taken from White Mustard at Manea, Cambs.; and I had an opportunity of seeing the *Meligethes* myself on both Brown and White Mustard flower at Coldham Hall, and Stags Holt, near Wisbech, in July.

These beetles are little more than the twelfth of an inch long, of the shape figured at p. 74, and of a deep greenish colour. The eggs are long, cylindrical, blunt at each end, and so transparent that the development of the maggot may be watched from the day after laying. Hatching takes place in four or five days. The maggot has a broad head, with sharp jaws, three pairs of legs, and also a proleg (at the end of the tail). When full-grown the maggots are yellowish white; earlier in their life they are usually somewhat spotted.

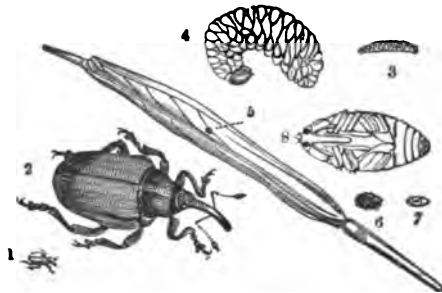
The method of life, as I observed it on various plants of the Cabbage kind, was as follows:—About the 6th of June *Meligethes* were to be found in great numbers in the blossoms apparently feeding entirely on the pollen (probably they had been about for some weeks previously); shortly afterwards eggs and maggots were noticeable. The eggs were laid within the unopened buds, and the maggots were to be found in profusion by the 17th of June in the buds and partially opened flowers, which were distinguishable by their stunted and shrivelled appearance. The maggots appeared to prefer feeding at the base of the blossom; presently they spread from the flowers and might be found in parties of a dozen or two at the base of the stalks of the topmost flowers; others distributed themselves variously, but chiefly on the seed-pods, where the gnawing motion of their brown jaws might be clearly seen against the light colour of the vegetation. Some of these maggots, which I had under observation, left the sprays on the 17th of June (by falling down), and then buried themselves as quickly as they could. About ten days later I found the chrysalis already formed in an earthen cell, about three and a half inches below the surface of the ground. Probably in natural circumstances, and the hard ground of a field, the maggots would not go down so deep.†

* As there are several kinds of *Meligethes* varying little from each other, I submitted some of the above specimens, for the sake of absolute certainty, to the thoroughly skilled examination of Mr. Oliver E. Janson, who reported that he found fifty specimens of the *M. æneus* and one of *M. picipes*.

† Life-history of *Meligethes*. By E. A. Ormerod, Ent. Monthly Mag., 1874.

The beetles shelter during the winter, and are stated by Dr. Taschenberg to come out from winter-quarters in April and to fly briskly about in bright sunshine.

The damage caused by these beetles does not seem open to any cure when they are on the blossoms, excepting the German method of shaking them off into any convenient vessel on dull shady days or early in the morning; but, though this is effective where it is possible to get at the plants, it is not applicable to a large Mustard field, and all that we know at present regarding means of lessening the amount of their presence appears to turn on rotation of crops and removal of winter shelter.



CEUTORHYNCHUS ASSIMILIS, Payk.

Beetle, maggot, and chrysalis, nat. size and magnified. Infested Turnip-pod.

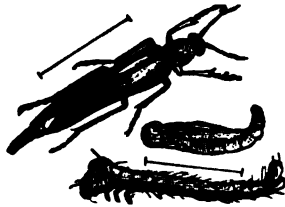
A fourth kind of beetle to be found on Mustard is the "Turnip-seed Weevil," figured above. This may be very easily known from the other three kinds by its dark greyish colour, and by its long slender curved proboscis. The maggot of this beetle feeds on the seeds of various plants of the Cabbage tribe, whilst these are still in the husk.

Specimens of the weevil were sent me, taken from Mustard near Peterborough; and Mr. Ernest Smith, writing from Southminster, Essex, mentioned:—"I have frequently seen the weevil you mention in the seed, but have hitherto regarded it as a harmless insect." We have not enough observations yet to know how much harm it does, but I have found seeds eaten out in samples of Mustard sent me, and should say that it would be well to know more about the extent of attack.

The list of contributors to the above Report is inserted on the page preceding the Index.

O A K.

The Dockyard Beetle. *Lymexylon navale*, Linn.



LYMEXYLON NAVALE.

Dockyard Beetle, maggot, and pupa; magnified figs., with lines showing nat. length (after figs. by Prof. Westwood).*

This beetle takes its name from the injury it causes to ship-timbers. It is stated to be common in the Oak forests of the North of Europe, and that it does not do great mischief in such localities, because it only attacks decaying trees, and not sound standing wood, but that felled timber, and especially ship-timbers, are badly perforated by its maggots.†

The injuries which were caused to dockyard timber long ago in Sweden by this attack are well known; since then Dr. Bernard Altum mentions similar injury occurring near the Adriatic Sea; and Prof. Westwood notes it as being occasionally so abundant in the dockyards of France as to cause considerable damage; also, in 1850, Professor Westwood mentioned‡ having received, in the month of June of that year, specimens of larvæ which he immediately recognised as of this beetle (*L. navale*), from a correspondent at Pembroke Dockyard. "They were found destroying the Italian Oak 'thick stuff' (the technical name for planks about four inches thick in store at that port). They were not seen when the wood arrived and was tested, but their ravages were becoming serious"; and the perfect insects were appearing by thousands in the Pembroke Dockyard in July.

It appears probable that this timber was in infested state, though not observed to be so, on arrival from Italy; but however that may be, up to the present time the *Lymexylon* has been a beetle rare in the extreme in this country, as an apparently true native; I am not aware that it was until last summer, when I received the following report of his own observations from Mr. Joseph Chappell, Chorlton-on-Medlock, Manchester, that notes have been given of it being found in large

* See 'Gardeners' Chronicle' for 1850, p. 677.

† 'Der Forst. Zoologie,' von Dr. Bernard Altum. Vol. III., Insecten.

‡ See 'Gardeners' Chronicle,' quoted above.

numbers in this country infesting living timber. Mr. Chappell mentions:—

“A few years since I found this dreadful pest in Dunham Park (Cheshire). I found *Lymexylon* at first at rest at the base of an Oak tree which had recently been cut down, and which had cracked slightly near the centre. On carefully examining it I perceived the ovipositor was insinuated into one of the cracks. I took four other specimens in the course of a week or fortnight, all of which were females.”

In the following season Mr. Chappell, with an entomological friend, cut them out of other trees, where they had infested the trunks in both the larva and imago state; these had been infested while still growing, and had recently been cut down. The insect was observed to run quickly on the trunks of the trees, and enter the perforations previously made by it almost before it could be secured without the captor being on the alert.

In the following season (the third year of observation) one was secured on the wing, and, following up this hint where to look for it, Mr. Chappell “found it freely on the wing, both male and female. It is a very high flyer. The perfect insects might be seen on the wing on hot sunny days, towering above the giant Oaks,—I should think about one hundred feet,—perhaps higher than the beautiful Purple Emperor Moth soars generally. It was only occasionally we could capture it by the use of a net on a long bamboo, and patiently waiting until it descends to lower regions.”

The beetle is of the shape figured at p. 77, and, as I have never met with the attack myself, I copy the description given by Professor Westwood*:—“The male is black, with the inner base of the elytra (wing-cases), legs, and abdomen dirty orange-coloured; the female is larger and brighter coloured, with the thorax reddish, the head, margin, and apex of the elytra and wings dusky black, the antennæ brownish black, and the legs pale fulvous.”

“The larva is a long, very thin, cylindrical, white, fleshy grub, like a worm, with a corneous head, the first segment of the body produced into a sort of hood over the head, three pairs of short-jointed legs, and the terminal segment of the body swollen.”†

With regard to the habits of this beetle, it appears, from the various observations, to attack the solid wood of old trees, or of felled timber, in which consequently the sap has ceased to be in movement. Dr. Bernard Altum notices it as occurring “on large old Oak-trunks, which are so far struck by decay that the bark has begun to loosen and fall away,” and that “it comes out of cracks of these trunks, and rests on stack or cord wood, and swarms from the beginning till the

* See ‘Gardeners’ Chronicle’ for 1850, p. 677.

† Id., p. 677.

middle of July, on warm days between two and four o'clock in the afternoons, with a heavy flight (or soaring) like that of the *Dermestes*.*

The state of things amongst the fine old Oaks at Dunham must be very similar to that described by Dr. Altum, as Mr. Chappell notes, "It is very probable that some of those giant Oaks in Dunham Park have had their existence terminated by it," for it is obvious that an Oak must have attained a very considerable age before the term "giant" can be applied to it.

The presence of this beetle must have been well established, as it will be noticed that the observations extend over three years, and the damage, by means of larval perforations, extended deep into the timber; for Mr. Chappell remarks that, accompanied by a friend, and both armed with tomahawks, they cut holes in the Oak twelve inches deep before they succeeded in finding the larvæ. These were "very long and slender, with the first segment after the head dilated, and the terminal segment produced into an obtuse lobe" (as figured and described by Prof. Westwood). Male beetles also were found at the same depth.

In regard to measures of prevention, there does not seem to be any necessity for guarding against the attack as far as concerns live timber in this country, as the beetles have been very rarely observed. If there should be a desire to prevent attack spreading amongst fine old trees past their prime, which there was some especial reason to preserve, the only way that appears possible would be to fell and burn such as were known to be infested, and thoroughly to tar all parts of the standing timber where the wood was exposed without bark, or where cracks in the bark could be found down which the female beetles could creep to lay their eggs on the wood below. It will be noticed that we have no mention of the beetles laying on bark of growing trees.

The great damage is always stated to be what occurs to timber in dockyards, and the remedy suggested by Linnæus of having the timber in the royal dockyards in Sweden placed under water during the egg-laying season of the Dockyard Beetle, to ensure the wood against the eggs being laid on it, is too well known to need repetition. At the present day the matter would be more easily met by some of the many chemical applications, which are cheap, easy of application, and thoroughly deterrent to insect-presence. Probably an application of some mixture of paraffin or mineral oil would give an obnoxious scent to the timber for quite long enough to keep off the July presence of beetles.

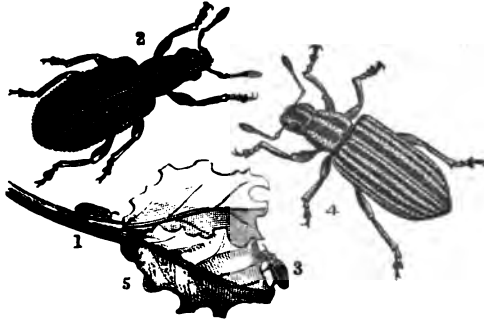
During the attack previously mentioned, when the *Lymexylon* broke out in such enormous quantities in Pembroke Dockyard, it was

* 'Forst. Zoologie,' von Dr. Bernard Altum. Vol. III., Insecten.

reported to Prof. Westwood (see paper previously quoted) that the maggots in the infested timber were destroyed by subjecting the wood in closed chambers to the action of steam for from eight to ten hours. This would check continuance of attack on the same spot very effectually, but I am not aware of the beetle being at the present time one of the regular injurious insects of this country.

PEAS.

Pea, Bean, and Clover Weevils. *Sitona lineata*, Linn.;
S. puncticollis (and other species).



SITONA CRINITA and *S. LINEATA*.

1 and 2, *S. crinita*; 3 and 4, *S. lineata* (nat. size and mag.); 5, leaf notched by weevils.

The following note, which was sent to me by Mr. Reginald W. Christy, of Boyton Hall, Roxwell, near Chelmsford, is well worth notice, as showing one of the situations in which the Pea and Clover Weevils, which are often such utter pests to the young crops in spring and early summer, and are to be found in legions on the "reapers" and in the waggons at harvest-time, spend their winter season.

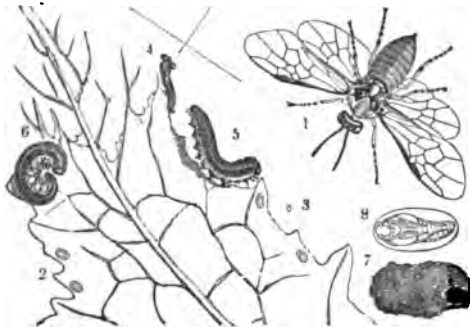
In this instance they came forth obviously from the stubble under pressure of weather, but in common circumstances they would have come out like many other kinds of beetles with the spring warmth to feed on their own special crop-food, and lay the foundation of a new attack.

"I think you would like to know of a fact which came under my notice on Jan. 6th last respecting *Sitona puncticollis* (or *lineatus*). After the heavy snowstorm we had on the 5th and 6th I found immense numbers of these beetles on the surface of the snow in a torpid state. The field was a barley-stubble, and the tops of the stubble just

protruded from the snow. I concluded that the weevils had hibernated in the hollow stubble, and that the snow had warmed them sufficiently to make them crawl out. Whether they got back again, or whether they were all blown off the frozen surface of the snow or not, I cannot say, but on the 7th there were none to be seen. This seems to show that they do hibernate in the imago state as well as the larva, and in large numbers, too, as I counted forty-one lying just in front of me whilst walking a hundred yards across this field."

TURNIP.

Turnip Sawfly. *Athalia spinarum*, Fabricius.



ATHALIA SPINARUM.

Caterpillars, pupa, and pupa-case. Sawfly, magnified, with lines showing nat. size.

In the course of enquiries regarding the Mustard Beetle and its caterpillar, sometimes known as "Black Jack," I received the following note from Col. Russell, of Stubbers, near Romford, regarding the caterpillar of the Turnip Sawfly, which goes popularly by the same name (that is, "Black Jack"); and as this insect, when it does appear, is rapidly destructive to Turnip-plant, I have (as suggested to me) added a few notes on the subject. Col. Russell observes:—

"The 'Black Jack' of your Report is not the caterpillar which I have known under that name. Some years ago these were very numerous and mischievous,—black caterpillars, something like an inch long, which eat off whole acres—sometimes whole fields—of White Turnip-leaves in autumn, leaving only the stalks and large ribs of the leaves. I have heard of flocks of tame ducks being turned into the fields to eat these caterpillars. Lapwings also are said to eat them. I do not remember seeing any of these for some years past.

Have they disappeared altogether? They are not noticed in your last Report, and I do not remember that they have been in the former Reports."

The Turnip sawflies are of a bright orange-colour, with black heads, and four transparent wings much netted over with veins (as figured), and yellowish at the base.

The first brood of flies appears in the early summer from out of the cocoons which have lain during the previous winter a little below the surface of the ground. The females lay their eggs on Turnips, and "all cultivated plants of the Cabbage tribe, and many of the wild Cruciferae, as Charlock, Winter Cress, and Hedge Mustard."*

The eggs are laid in small slits in the leaf, which are cut by the "saw-like" egg-laying apparatus of the female, whence this family takes its common name of "Sawflies." One female is stated to lay as many as a hundred eggs. The eggs hatch in a few days, more or less according to the state of the weather being favourable or otherwise. The caterpillars are stated to be greenish white when first they come out of the egg; afterwards they are black, with a paler stripe on each side; and later on, when nearly full-grown, are slate-colour (with a pale stripe as before), and pale beneath. They have in all two-and-twenty feet (that is to say, a pair attached to every segment, excepting to the head and to the fourth segment from it, which is footless. The sooty colour, which they have almost throughout their lives, is the reason of the common names by which they are known variously, as "Black Jacks," "Blacks," "Black Palmers," "Niggers," &c.

The caterpillar feeds for about three weeks, and then goes down into the ground, where it forms a cocoon, in which it turns to the chrysalis condition.† From this the perfect insect comes out during the summer, after about three weeks, or in a shorter time, if the weather is hot. Later in the season these changes are not gone through so rapidly, and in observations of the winter cocoons the

* 'Praktische Insekten kunde,' von Dr. E. L. Taschenberg, pt. ii., p. 819.

† The description given by the well-known entomologist, the late Mr. Edward Newman (in his 'Letters of Rusticus'), of the method of formation of this earth cocoon is of much serviceable interest, showing, amongst other points, the thorough protection afforded by the case to the living contents:—"When the 'nigger' has reached his full size, a period depending on the temperature of the weather and the supply of food, but averaging at twenty days, he burrows in the earth, and there makes a little oval house, just big enough for his body, which has all at once become shorter and thicker; he then plasters the walls of this place with a sort of sticky varnish or glue, which he discharges at this time only: he keeps on discharging and spreading this glue till he is quite surrounded with a strong, tough, and hard cocoon, the particles of earth being mixed with the glue, and the whole forming an admirable and perfect defence against wet and the attacks of insects."—'Letters of Rusticus,' p. 103.

grub is recorded by Mr. Edward Newman as having been found by him lying within, and very little altered in the following May. From these chrysalids, as mentioned at the beginning of this account, the perfect sawflies come out to start the first attack of the summer.

The mischief caused by the sawfly-caterpillars when they appear, as is sometimes the case, in vast hordes, is enormous. They may be found swarming on the leaves, and will very rapidly clear away all that is not too hard to eat. Severe attacks have been recorded at intervals (and once during four successive years) since 1756, but I am not aware of a bad widespread outbreak having taken place for several years back.

In 1880 Mr. Robert Service, writing from Maxwelltown, Dumfries, mentioned that he had often met with the insect whilst collecting, and had met with it that summer as usual, but that it was rarely injurious in that neighbourhood; and in 1882 Mr. George Brown, writing from Watten Mains, Caithness, observed that a slight attack had occurred. He noted that "the damage sustained was but trifling; still, where they were at work can easily be seen, as there is nothing left of the leaves but the ribs."* The only occasion on which I have seen the attack myself—and then only as occurring to a slight extent—was on a Turnip field at the top of the cliffs above the Severn, at Sedbury Park, in W. Gloucestershire. This was in the autumn, and accompanied a high wind. From the state of the sawflies on first observation it appeared as if they had been carried by the gale from fields lower down the Bristol Channel, and thrown, partly exhausted, on the crop at the first high level, and very slight presence of caterpillar followed.

Very little can be done to prevent this attack, as we very rarely know when it is coming, but when it is present all the measures which succeed in checking attack of Turnip Fly by shaking the pest from the plants, such as sheep-driving, brushing with boughs, &c., and in all probability dressings obnoxious to the grub, will answer much more surely in the case of this attack, for the following reasons:—

The Sawfly-caterpillars eat voraciously, consequently grow fast, and therefore have to change their skins frequently, every six days or so. When this moult takes place they have to fix themselves firmly by the tail-pair of sucker feet to some part of the plant, so as to gain a point to pull against in drawing themselves out of the old tight and dead skin. If they cannot manage this they die in it. Therefore all measures which disturb them in this operation are very practically useful to us.

Also, it appears that up to the time of the first moult the caterpillar has the power of spinning a thread, by which it can let itself

* See Reports of Observations of Injurious Insects respectively for 1880 and 1882.

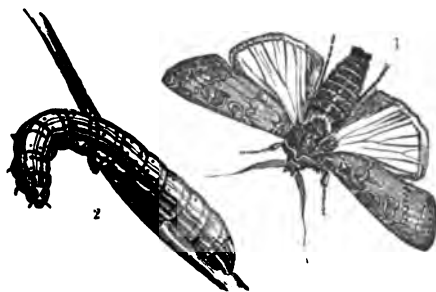
down on alarm, and (like many other kinds of caterpillars) return up the line to its food-plant when the alarm is over. But *after* the first moult the power is stated to cease, the caterpillar rolls itself up in a ring, and is easily dislodged, and falls to the ground. In this way, when the whole family at work on each plant is dislodged, some at least are killed by whatever the application may be, and there is a temporary respite.

Mr. Hart, of Park Farm, Kingsnorth, Ashford, Kent, reported, in 1880, that in August he had "used sheep and lambs with good effect in an attack of "niggers" on Turnips. About a hundred of them were driven backwards and forwards for an hour three days in succession, which *quite cleared the plants*, and did no harm to the animals. The attack was noted by Mr. Hart as the only one of the kind which he ever had to deal with, and he tried several other kinds of treatment before resorting to the droving, but they were all useless.

There is the special advantage, with regard to droving, that many of the grubs are trampled to death by the sheep; but any measures that will make the grubs fall down are serviceable. Any treatment that may give a temporary check to the plant whilst attack is on is particularly to be avoided; therefore singling and hoeing at such times are in no way desirable.

Where a Turnip field has been infested during autumn it is desirable to work the surface with a scarifier or grubber, so as to turn up the cocoons to the surface, where a good proportion of them, with their contents, are likely to be destroyed.

Surface Caterpillars; Caterpillars of the Turnip or Dart Moth. *Agrotis segetum*, Westwood.



AGROTIS SEGETUM.

Common Dart Moth; 1, moth; 2, caterpillar.

The following notes regarding Turnip caterpillars all refer to useful practical points, as—the benefit of a good state of land (such

as is neither sodden, nor with the moisture just below the surface dried out of it) at sowing-time, as a means of keeping up the crop under attack; attack of Turnip caterpillars to Mustard; the free use of drags and harrows amongst young roots as a means of disturbing the Turnip grubs, and bringing them within reach of Starlings and other birds; the serviceableness of hand-picking; and likewise observations of the grub being found alive in the ground amongst Cabbage-stumps during February. This last point is very well worth notice, for, though it is part of the regular history of this grub to live—and, circumstances permitting, to feed—through the winter, so little attention is paid to the matter that in due season many a hatching of moths is allowed to take place, and start attack on the young crops, which might have easily been prevented by a timely ploughing, which would have turned out a good proportion of the half torpid grubs to destruction.

On August 22nd Mr. Thomas Flower, of the Manor Farm, West Knoyle, Mere, Wilts, forwarded the following communication regarding attack by surface caterpillars to Turnip and Rape, which is of interest regarding the safety, or the bad injury, respectively occurring to the portions of the crop drilled on the first day of sowing before rain, or after a few days interval in wet weather. Specimens of caterpillars were sent accompanying. Mr. Flower mentioned:—

“The crop is drilled, three rows of Turnip and one of Rape. The first day’s drilling took place before the late rain, is of clean Rape, and has not been touched by the grub. The next day’s drilling of Rape and Turnip put in in wet weather after a few days interval is almost destroyed; in all about thirty acres is attacked by these pests. The soil is light flinty and backward. . . . One interesting fact is, the grub scarcely touches the Turnip, but destroys the Rape as it goes, and is to be found in the day-time hidden in the ground close to the root of the plant.”

(The method of feeding of the Turnip caterpillars, as they are called, though they feed on many kinds of plants, alters as they advance in age; when first hatched they are considered to feed chiefly above ground, or rather on the part of the plant just at ground-level, as often observable by the young gnawed-off plants which are to be found lying about; when older the grubs generally feed under ground, or come up at night to feed.—ED.)

The following report is from Mr. W. Farrant, of Stokes Farm, Wokingham, sent with specimen of Turnip caterpillar accompanying, on the 19th of August. It will be seen, in the case of two portions of a field of Turnips treated with the same farm manure, the same artificial manure drilled with the seed, and the seed in each portion drilled on the same day, that the portion which was ploughed

and laid in furrows about three weeks before being drilled was almost destroyed, whilst the portion which was ploughed one day and drilled the next escaped. Mr. Farrant mentions:—

“I herewith send you three grubs. . . . I found them in a field of common Turnips after Vetches. The Vetches were mown and carried off for horses and cattle, twelve loads of farmyard manure per acre put on and ploughed in, and 4 cwt. superphosphate and dissolved bones in equal quantities (drilled in with the seed) per acre.

“The spot attacked by grubs was where the Vetches were first cut, and the land ploughed directly and laid in the furrows about three weeks before being drilled; in the rest of the field dunged in the same way, but ploughed one day and drilled the next (the same day and in the same manner as the attacked spot with two pounds of seed per acre), the seed grew well. The attacked spot will not be worth standing, whilst the other is looking well.”

The following observations, sent on the 28rd of August from Woolhampton Farm, near Reading, are of considerable interest, in reporting attack of the *Agrotis segetum* larvæ on Mustard. Specimens of the maggots were sent me, which I could not find to differ in any way from the common Turnip caterpillar, and (as we know well) several of the common Cabbage and Turnip insects also attack Mustard, there does not appear to be any reason why this caterpillar should not likewise feed similarly.

Mr. Colbauen mentioned that he sent me “some specimens of a grub which had made great havoc lately in a field sown with Mustard for ploughing in green. The field is almost fifteen acres in extent, the soil being for the most part a light sandy loam. Large patches an acre or more in a place are almost entirely cleaned off, and there is a general thinning of the plant over the whole ground. At the base of the plant attacked there is a hole in the soil, from which the grub comes forth to feed upon the stem from its base upwards, as in the specimens sent. We have repeatedly grown Mustard in this neighbourhood, but have never known it to be attacked in a similar manner before.”

Relatively to the attack of this grub or caterpillar to other plants, Mr. Colbauen remarked:—“I have battled with this enemy for many years, and have treated it with all sorts of dressings, but never found anything so effective on a large scale as the free use of the drags and harrows, especially amongst young roots. I have this year over 100 acres of good Swedes, Turnips, and Mangolds, only saved by the free use of the harrow. This brings the grub to the surface, so that the Rooks and Starlings can pick them up. I fancy Rooks do not care much for them, if they can get other food; but Starlings seem very fond of them. I have a small patch of Mangold planted on the ridge

which we could not harrow, and, as it may be interesting to you to see how the bulbs have been injured by this creature, I have forwarded a specimen root, together with two of the caterpillars. Lime and chalk are great helps in getting rid of these pests; they do not like gas-lime."

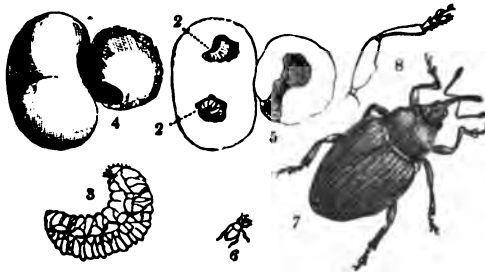
The following short note from Mr. James Craig, Weston-under-Lizard, Shifnal, Salop, refers to the benefit received from hand-picking:—

"I had large numbers of the grubs picked from the roots of my Turnips last year, after hearing from you, and thus, I think, saved a good portion of the crop."

The following note relates to the fact (which is not usually enough considered) that unless the Turnip grubs are destroyed by some means, natural or artificial, they will live on through the winter, and start fresh attack next year from the moths to which in regular course the caterpillars change.

Col. G. Coussmaker, writing from Westwood, near Guildford, observed:—"As regards my particular enemy the Dart Moth, I was astonished this last winter, in the middle of February, when pulling up some Cabbage-stumps, to find some of the caterpillars alive in the ground, and seemingly none the worse for the hard frosts which we had had."

Turnip-gall Weevil. *Ceutorhynchus sulcicollis*, Stephens.



CEUTORHYNCHUS SULCICOLLIS.

1—5, gall with maggot, nat. size and magnified; 6 and 7, weevil, nat. size and magnified; 8, leg of weevil, magnified,

Enquiries are occasionally forwarded regarding weevil-galls on Turnips. The appearance of these knobs or gall-growths on Turnip bulbs is very well known, and where they are only in small numbers they are of little consequence, but when numerous they spoil the appearance of the Turnip, and cause some amount of damage. But,

besides what harm the attack may cause, which, in the case of Turnips, except in rare instances, is perhaps not very much, the injuries are so often confused with those caused by the very destructive fungoid disease, known as "Anbury," "Fingers and Toes," or "Club," that a short note may be of some interest.

The galls caused by weevil-attack are simply roundish knobs, sometimes a few in number and separate from each other, sometimes in clusters, and, according to the stage of development, they may either be just a mere small swelling on the outside of the Turnip, or may project more, so as to be about the shape of a bullet cut in half, fixed with its flat side on the Turnip, or sometimes even more than this, so as to be of the form of nearly three-quarters of a bullet, or, in bad cases, they may be joined in clusters. Inside the galls are of the same (or of very nearly the same) condition of cellular tissue as the mass of the Turnip bulb itself, only with the centre eaten away by the maggot, and outside they are covered by the same kind of bark or rind as the part of the Turnip bulb on which they grow. This healthy state of the tissues, and regular, though abnormal, form of the galls, will be found to distinguish gall-attack very clearly from true "Anbury."

The beetle which gives rise to these Turnip-galls, and likewise the Cabbage-root galls, is a small blackish-grey weevil, with a long proboscis (see figs. 6 and 7, nat. size and magnified). The female lays her eggs either on the outside of the Turnip, or more probably just under the skin, by making a little hole for it with her proboscis, and from this egg there hatches the gall-maggot. This is a fleshy, whitish, legless maggot, with a head furnished with a pair of strong jaws. Those of the Cabbage and Turnip-gall maggots which I have examined were furnished with three finger-like teeth at the extremity.

From the irritation caused by egg-laying, or connected with the presence of the egg or maggot, the swelling known as the gall begins to form, and inside this the maggot feeds until it has formed a large cavity in the gall. When full-grown it gnaws its way out into the earth, and there it builds itself up a case or cocoon of the little fragments of earth or sand which are in reach, and in this cocoon (which lies in the cavity in the ground formed by the material for the earthen case being taken out of it) the maggot changes to the chrysalis-state. The maggots both of the Turnip and Cabbage galls appear little liable to injury from being thrown out of the galls before they are full-grown, or from having their cases broken afterwards. Those I have watched almost immediately buried themselves in the earth, and, if their earth-cocoons were broken they would make new ones or repair the damage.

The time occupied from the disappearance of the maggot into the

ground to the reappearance in complete development as the perfect weevil was, in the observations which I took in the middle of summer, never less than fifty-four days, and never more than the space of two months. I did not find that there was any difference between the weevils raised from maggots taken from Turnip or from Cabbage galls, and the maggots also were alike, excepting that the Turnip maggot was rather more ochreous than the other.*

When the galls are established on either Turnip or Cabbage there does not appear to be any remedy which can be brought to bear on the mischief that is then going on. Partridges are said to be very fond of the maggots, and to frequent Turnip fields for the purpose of pecking them with their bills out of the galls; but (as one great part of the damage of the attack consists in the escape of the maggot causing holes by which wet and injurious insects make their way into the Turnip) the still larger openings down into the gall-cavity caused by the birds' beaks are a doubtful benefit.

Good dressings of chalk and lime are stated to be good preventives, and so likewise is gas-lime. Anything that is injurious to the maggot, and which can be mixed in the earth into which it creeps from the gall to build up its earth-cocoon, must necessarily be brought strongly to bear upon its system, if not poison it outright. The maggots build up their cocoons by taking small fragments in their jaws, and adding them by means of a kind of gummy secretion from the mouth to the forming case, and if there is a supply in the soil of what is bad for them, and which will be partially swallowed in the house-building process, it cannot fail to be a preventive of increase. They have been recorded as going down out of the way of such annoyance deeper than the natural position for their change, and anything that places an insect when going through its changes in unnatural circumstances is very bad for it.

In garden cultivation the chief preventive is fresh deeply-dug soil, and to avoid ground on which Turnips or Cabbage have previously been grown.

* Maggots taken from Swede-turnips were of a still yellower tint, and those I observed differed in the small outside third tooth of the jaw, which was present in the Turnip and Cabbage-gall maggots, being absent; so that the jaws of the Swede weevil-maggot had only two teeth. I did not succeed in rearing the weevils from these, so cannot say whether they were precisely the same species.

WARBLES.

Horse Warble. ? *Hypoderma Loiseti*, Loiset; ? *Hypoderma equi*;
? *Ædemagena equi*.*

During the spring of last year my attention was directed to warble attack on horses, by Mr. H. Thompson, M.R.C.V.S., of Aspatria, Cumberland, who forwarded me a maggot which he had recently taken from a warble on the neck of a horse placed under his charge. On making enquiries it appeared that this kind of attack had not been generally observed, and also that it is not known with certainty what kind of Warble Fly (that is, what species of *Æstrus* or *Hypoderma*) it is that causes the warble. Therefore, during the past season, I have been endeavouring to gain some information as to the nature and amount of prevalence of the attack; and, so far as we have advanced, the following may be given as an abstract of the observations with which I have been favoured.

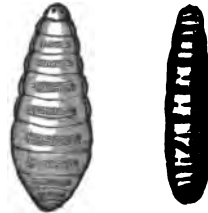
Warble attack has been noticed either on the living animal or on the removed hide at the following localities:—Wigton and Aspatria, Cumberland; near Tarporley and near Birkenhead, Cheshire; Hereford; Cirencester; Newport, Mon.; two localities in Cornwall; Downton, Hants.; Ely, Cambs.; and Lincoln;—so that the attack appears to be pretty generally distributed.

* The description of the larva given by Dr. Friedrich Brauer (although even in this case it is of the maggot before complete development) may be of some service in identifying the species in the coming season, and I therefore append it as a note, together with references to the authorities quoted by him, which, as far as I am aware, are all the published notes on the subject. Dr. Friedrich Brauer writes, in his 'Monographie der *Æstriden*':—

"The larva is oblong, thick, inflated at the fore part, and slightly smaller at the hinder part. The mouth is small, edged with a black border, and surrounded with prickles, which are scarcely visible to the naked eye. The first segment is the smallest of all; the five following increase up to the full breadth; the last five lessen considerably. On the under side of the segments it is observable that the surface (with the exception of that of the last two) is divided by a transverse furrow into two unequal portions; of these each is furnished with a number of prickles, of which those on the foremost half of the segments are placed with their points directed backwards, and those on the hinder half with their points directed forwards. On the last segment there are two horny spiracle plates. On the back the larva is nearly bare, excepting a slight amount of prickles on the first three segments. The body is white; the prickles dark brown. The skin of the larva is transparent. Enlargements at the side of the segments (*seiten-wülste*) either absent or inconspicuous. Length, 9—10 mm. On the under side of the second segment there is a cushion, which serves as a "pseudo-foot." This is probably only a form of side enlargement."

"From the description it will be seen that the larva may be judged to be in the second stage, in which it does not appear to show any especial difference from

The largest number of warbles noted on one horse were three or four, but usually not more than one was observed; but the mischief caused by this one either is (or has a capacity for being) much more serious than what is caused by any one warble on cattle. In the notes sent by Mr. Thompson, it will be observed that in the case of the horse suffering from warble, which was brought to him for veterinary advice, the swelling from the warble on the neck extended to the extremity of the shoulder-blade. Other notes of local tenderness of the part affected were given. It will also be noticed that the locality of the warbles is not (as with cattle) specially along the back, but they are also to be found on the neck, flank, and quarter. The only uninjured specimen I have seen much resembled the early stage of the Ox Warble maggot before it has gained the oval shape (see fig.). It appeared to me that the bands of prickles were more obvious, likewise that the prickles were larger than is the case with Ox Warble larva at this stage, likewise that some of the divisions of the segments or cross furrows were deeper; but as the specimen was apparently not advanced to the final moult it could not be satisfactorily identified. In other specimens, examined by Mr. A. Martyn (see p. 98), the mouth-hooks were observable, and similar, or nearly similar, to those of *H. bovis*, and the duration of the chrysalis stage was found by him to be about twenty-seven days.



Ox Warble maggot, in two stages, much magnified.

The only other observations which have been contributed regarding points of structure of the maggot, or of the history of its development

others of the genus. To distinguish whether it is the larva of the *Hyp. bovis* or of another kind, we must know the third stage. It is very likely that it belongs to another kind, possibly *H. silenus*."

"The larvæ have, up to this time, been observed in Spain, Italy, in the North of France, Belgium, Holland, and on the coasts of the North Sea, in warbles on horses. The statement of Joly that it occurs occasionally in the South, I consider to be inaccurate. I have never observed it in Vienna, nor on Hungarian horses. The swellings are found along the vertebral column on the back of horses, and are observable in May and June. Such horses especially suffer as in July and August of the previous year were exposed in the pastures to *Estrus* attack."

"Note.—The larvæ observed by Roulin, in America, under the skin of horses, appear to belong to the *Dermatobia*."—*Monographie der Estriden*, von Friedrich Brauer, Wien, 1863, pp. 137, 138.

The publications on the above subject, mentioned by Dr. Brauer, are:—Loiset, Note sur l'œstre cuticule du cheval, Mem. Soc. veter. d. l. Manche et du Calvados, p. 197, 1844 (*Edemagena equi*). Joly, Recherche s. l. œstre, H. Loiset, p. 241, 1846; and Joly, Comptes rendus d. l'academie, p. 86 (*Hypoderma equi* die larve, 88), Paris, 1849.

up to the perfect fly, were sent me by Mr. A. C. C. Martyn, a student at the Royal Agricultural College, Cirencester, who is well qualified to report on the subject, as in the previous year he had succeeded in rearing twenty to thirty Ox Warble flies to maturity from the larval state. During the past summer Mr. Martyn secured various Horse Warble maggots, and reared two of them up to fly state, these maggots being taken by himself from warbles respectively in the back of a colt and of a cart-horse. In one of the maggots the mouth-forks were noticeable on microscopic examination, and were stated by Mr. Martyn to be very similar to those of the young Ox Warble maggot, as sketched at "1" in the accompanying figure, repeated from last year's Warble report; the existence of bands of prickles was also noticed.



Mouth-forks of very young maggot of Ox Warble, much magnified.

Of the two maggots which were reared to development, one was kept in a temperature of 100° Fahr., and remained in the chrysalis state for twenty-seven days. The fly which then emerged was reported by Mr.

Martyn to resemble the Ox Warble Fly, but to be in his opinion somewhat longer in shape. The fly died in two days, and shrivelled up. In the case of the second maggot, which was reared to development, the craving for warmth was plainly showed. The box in which it was secured was covered with a convex lens, and on this being placed out of doors the larva drew itself from the darkened corner, where it had been laid, into the rays of the sun. These points agree with what I have noticed of the Ox Warble maggot, which I have seen restored when seemingly dead by being held in the warm hand, and which have power of movement, when free from the warble, in a selected direction. In both the above instances the flies soon died, and shrivelled or putrefied, so that they could not be kept as perfect specimens.

The first communication which I received regarding observation of the warbles was from Mr. Hy. Thompson, M.R.C.V.S., of Aspatria, Cumberland, who wrote to me on the 16th of April, as follows:—

"To-day I send you a warble maggot, taken from the neck of a thorough-bred horse. This is the third which I have removed during the last two years. The opening in the skin was about the size of a mustard-seed. About four hours before the animal was brought to me a small swelling was noticed, but to-day the swelling was diffused and extensive (nearly all the length of the shoulder-blade). The warble came away with very little pressure, but the parts were very painful.

The other two warbles were in the same animal,—one on the ribs, one on the quarter. About this time last year both places were very much swollen."

On the 27th of April Mr. Thompson mentioned that another warble maggot had been taken (also out of the neck) from the same horse; and on the 14th of May Mr. Thompson wrote regarding another maggot, which had been forwarded:—"This is the third from the same animal, which is very peculiar, as you seldom see them. The extensive diffused swelling and effusion they cause in the locality attacked is something very remarkable; not so in cattle."*

Messrs. C. and H. Hatton, of the Barton Tannery, Hereford, favoured me with information that they had known a few cases of horses being attacked by Warble Fly, but had never received a hide showing the effects.

On June 4th Mr. W. Fream, Professor of Zoology at the College of Agriculture, Downton, wrote me as follows:—"Regarding your query about warbles in the horse, I have only known one case. It occurred in a farm-horse here about six weeks ago. I was making inquiries, and learnt that the grub had been squeezed out only on the previous day."

On Oct. 9th Mr. A. C. C. Martyn, student at the Royal Agricultural College, Cirencester, and writing from thence, mentioned that the attack was very rare in that neighbourhood, as he had only found one instance, although he had been to almost every farm within six miles of the College. In this case one warble had been observed, and the maggot squeezed out, and no more information was procurable about it.

In Cornwall, however, during the past year, Mr. Martyn had observed two well-marked instances of attack. The first was in the case of a colt, which he noticed in a field, under a hedge, flicking his tail and trying to bite at something on its back. On being caught and examined the animal was found to have three large swellings on its back, from two of which Mr. Martyn took the maggots. The second instance was of a cart-horse, which had three or four warbles on its back, these so far advanced that the air-pores at the end of the tail were visible, lying, as with the Ox Warble maggots, in the opening of the warble.

* This third maggot had been forwarded to me in Mr. Thompson's absence, and, though still in the cylindrical or worm-like stage, differed from that above described in not having any prickles, excepting a few much scattered at the tail extremity, and possibly, but not certainly, a few at the mouth end. The caudal breathing-pores were still very small, and the form of the mouth-hooks not clearly discernible. This maggot was so very different in amount of prickles to that forwarded to me by Mr. Thompson that I cannot take on myself to form an opinion of the species.

On July 25th Mr. Geo. Moore, Secretary of the Wisbech Chamber of Agriculture, mentioned, in reply to my enquiries regarding warbles in horses :—" Mr. Luddington, of Ely, informed me that a few days ago he squeezed a warble-maggot from one of his horses (a nag-pony) fully developed, but not quite so large as the Ox Warble."

On June 17th Mr. Ralph Lowe, of Sleaford, Lincolnshire, mentioned a case of a horse purchased at Lincoln putting up "one warble swelling similar to those on cattle."

Mr. Gaskell, of Prenton Hall Farm, near Birkenhead, also informed me, in conversation on the 18th of May, that he had at that time a young horse with a warble on his back; and Mr. W. Bailey, Head Master of the Aldersey Grammar School at Bunbury, Tarporley, Cheshire (an agricultural district where, as noted in the paper on Ox Warble Fly, the pupils have been doing good service in exterminating the latter pest), wrote me, on May 7th, that one of the boys, whilst grooming a colt during the previous week, had found a swelling on the neck, and squeezed out a warble-maggot; and that about a month previously two others of the boys had squeezed one out of the flank of a cart-horse. A careful inspection was made as to whether more warbles were present, but no more were found.

As the above kind of attack has not hitherto been much observed in England, it may be of some service to draw attention to it, as one which may (if occurring on a tender part, or one liable to be rubbed by the saddle) give a good deal of trouble if not attended to in time; and likewise as explaining the nature of lumps or knobs, of which the cause is not always fully understood. In the coming season I should be greatly obliged if those who have warble-maggots removed from horse-warble would favour me with specimens, and still more, if any who may develop the perfect fly would let me have the opportunity of examining it, as it would be both of use and interest to know the precise kind.

On May 31st I was favoured by Mr. Stratton, of the Duffryn, Newport, Mon., with the following information :—" I have often seen warbles in horses, and they differ from those in cattle in the way you describe. You seldom find more than one in a horse, and that one is sometimes not in the back. . . . I have just now been examining one in a three years' old colt."

There appears to be peculiarity in some instances as to the size of the orifice, or date of opening of the warble, or duration of time during which it continues open; for Mr. Stratton noted, there does not appear to be any visible orifice in the warble as in the case of cattle, and, though in some cases the orifice is reported as large enough to allow of the breathing-pores of the maggot being seen, it will be observed by the following report of Mr. Dalton (which I have drawn attention to

by italics) that he has not noticed a scar on the healed wound in horse-hide similar to what exists in cattle-hide. Mr. Dalton, who in previous years had favoured me with excellent observations regarding warble-presence reported as follows :—

“ With regard to your question about warbles in horses, I can give you but little information. Of the horse-hides I get I should say not one in fifty is warbled, and the appearance of the hides when tanned shows that warbles in the horse are of rare occurrence ; *there is no cicatrix as in cattle*, and when a warble does exist it is a single one, and never, so far as I have seen, in numbers. As horses are not used for food, the hides are comparatively scarce, and only a few—and these mostly old ones—come under the observation of the tanner. I never remember seeing more than *one* warble-hole in a horse-hide ; I mean in any single hide. Whether it is the same species of warble as in the ox I cannot give an opinion ; I am inclined to think it is the same, . . . but this is, of course, mere supposition.”

In regard to presence of warble in imported hides, Mr. Dalton wrote :—“ Horse-hides are imported in large numbers from South America ; the Spaniards rear horses in immense quantities, and kill them for the hides and feet. They are slaughtered at two or three years old, and these hides are quite free from warbles.”

Ox Warble Fly. *Hypoderma bovis*, DeGeer.



Maggot.



HYPODERMA BOVIS.



Chrysalis.

During the last season the chief points which have been brought forward regarding Ox Warble attack are the ease with which the warble-maggot may be destroyed, and the absolute certainty of greatly lessening amount of future attack by a little timely care in getting rid of maggots in the spring.

Where these are destroyed necessarily the summer hatching out of the warble-flies is lessened precisely in the same proportion, the cattle are (similarly) saved in proportion from summer disturbance, and from new deposit of maggots in their backs, and as the flies, as far as we know, are exceedingly short-lived and do not go far from where they came out of the chrysalids, each cattle owner has the

benefit of the trouble he has taken. This point is very observable in the following notes.

The various simple applications or measures by which the warble-grubs may be killed or removed with little trouble or cost, and much benefit to the animals have been mentioned so fully in previous Reports, that there is no reason to give them again in detail. It will be seen from the following instances that various different applications may be used with success; but, looking over the reports sent in for the two last years, McDougall's dip or smear appears to be generally preferred.

Where the owner or superintendent can himself direct operations, the application of mercurial ointment, *once*, and as a *small touch*, on the black-tipped tail of the maggot, as seen in the open warble, is a treatment which thoroughly and rapidly kills the grub, and does no harm to the cattle. But where the ointment is put on carelessly, or *in great quantities*, the application is too unsafe to be advised. Squeezing out the maggots is a sure cure, and, though somewhat unpleasant to the animal, is so popular that there is a chance of it being carried out to a useful extent; but, as mentioned in previous years, almost any application of a greasy or sticky nature, thick and firm enough to remain on the opening of the warble sufficiently long to choke the breathing-pores of the maggot within, or, again, of anything which will run down into the warble-cells and poison the maggot without injuring the animal, will be of use.

In the following notes I should particularly wish to draw attention to the first communication (by Mr. J. A. Smith, of Rise Hall, Akenham, near Ipswich) as to the detriment to dairy cattle caused by warble-presence, and also to that immediately succeeding by Mr. D. Byrd, of Bunbury Heath, Cheshire, relatively to the good effect of preventive measures.

Mr. J. A. Smith, writing from Rise Hall, Akenham, mentioned:—“McDougall's smear or dip has apparently cured the bots on my purchased cows. I noticed that the animals affected seemed irritable under the attack, and this caused them to be troublesome to the milker. You will easily perceive that this is prejudicial to the milk-record, besides leading to a permanent loss, as well as trying the temper of the milkman. An inspection of the animals in our cattle markets at this season will convince the most superficial observer of the loss inflicted by bots on our herds and oxen.”

Mr. D. Byrd, writing from Bunbury Heath, Tarporley, Cheshire, on April 4th, mentioned:—“We dressed our dairy cows with dry sulphur, as I informed you, and they are very free from the warble; at the same time there are a few with suspicious lumps, that we shall notice to find if they are old sores or the warble in progress.”

On August 21st Mr. Byrd wrote further:—"It is pleasing to know that the Warble Fly is greatly lessened; the maggots must have been well looked to, and the preventive measures properly applied. We are all greatly indebted to you for the information how to destroy the maggot, and stock-keepers have wisely attended to instructions."

On March 12th Mr. W. Bailey, Head Master of the Allersey Grammar School, Bunbury, near Tarporley, wrote me that Mr. F. Ravenscroft, one of his pupils, had examined 114 head of stock belonging to his father and brother, and "so far had found no trace of the warbles"; and later on, on the 2nd of June, Mr. F. Ravenscroft, writing from Calveley, Tarporley, reported, as below, that there had been little trouble from warbles in the stock which had been dressed in the previous year, but they were found in young stock which had not been dressed. "We are not much troubled this year with the ox warbles. Last year's dressings have nearly stamped out this pest. We have, however, some of these maggots in the young stock which were not dressed last year, as they were out in the fields. I have this year applied the smear [McDougall's, Ed.] to them, though I prefer, if possible, to squeeze them out, as I am not sure whether it is a good thing to leave the dead maggots in the beasts."

The following note regarding efficacy of McDougall's dip was contributed by Mr. John Searley, of the Croft, Wainfleet:—"I have several warbles on young cattle: have tried McDougall's dip, and find it effectual. Some of the more mature bots came out, or were squeezed whilst being dressed. Others seem to rot in a few days."

On February 4th Mr. John M. Moubray, of Broom Court, Alcester, favoured me with the following note:—

"My cattle have been very much troubled with warbles. The summer before last, in the end of May, I dressed them with McDougall's sheep-dip, repeating the dressing occasionally till the end of August. The result was most satisfactory, as the next year they were almost free from them. I shall in consequence always continue to dress them so. I fancy that yearling cattle are more subject to the attacks of the fly than older cattle."

The following note from Mr. J. A. Farrell, D.L., of Moynalty, Kells, Ireland, mentions a glycerine dip as serviceable. "I have treated a good many cattle of all ages this season with glycerine dip, with very successful effect. I think it adheres longer to the coat than McDougall's dip, and it has the effect of improving the hair, especially in calves."

The two following reports refer to the use of mercurial ointment. The first is from Col. G. Coussmaker, of Westwood, Guildford:—

"My experience of warbles in the cattle is now this much:—In 1884 the majority of the cows and heifers had each from five to twenty in their backs. I got mercurial ointment, put some on myself, and showed the stock-man how to use it. In 1885 there was much less, and now there is hardly a case among sixty head; so I think that, thanks to your advice, my animals have now more ease. When I first began to talk to the men about it they said that it was nothing,—cow-stock always had these things; it did them no harm, and, as a rule, those which were in best condition were more likely to have them, and, in fact, that it showed the animal was healthy and thriving. Curious argument."

On April 4th, Mr. E. E. McBride, of Glendonagh, Midleton Co., Cork, wrote as follows:—"You will remember our correspondence of last year on the warble. I went carefully over all my cattle and poisoned the grubs with mercurial ointment, and I gave several of my neighbours some, and their cows were also treated. So careful was I with my own beasts that I do not think a single live grub escaped on this farm. The result is that this season the warbles are decidedly fewer, many of the cows being quite free from them."

It has now been proved by the information contributed during three successive years (for which I am indebted to cattle owners, dairy farmers, and others well acquainted, veterinarily and practically, with the management of cattle) that by a little care bestowed in the early part of the season, in destroying the maggots before they leave the warbles, that warble-attack may be so lessened as to be of no serious injury,—in fact, may be almost "stamped out"; and further, as before mentioned, that, from the nature of the warble-flies, this is one of the attacks in which each man benefits by his own work.

Communications have been sent in from tanning and hide firms, notably from such centres as Newcastle, Wigton, Birmingham, Hereford, Bristol, Taunton, Exeter, and from elsewhere, with mention of great extent of the losses sustained, and often urging strongly on myself to take all measures in my power to draw attention to the public loss. I have also information from those inconvenienced by the damage to the injured hides, affecting (that is to say, causing both trouble and loss to) manufacturers of goods from the perforated leather.

But still there is enormous difficulty in getting action taken to destroy the pest. I believe that the root of the difficulty is *ignorance and carelessness*. Until a very few years ago the history of the attack was not generally known; now, through the observations taken in Great Britain and Ireland, not as abstruse scientific points, but as simple everyday facts, all can know, and see exactly for themselves, how the matter lies; but there is still (and necessarily and without

blame, for those alluded to have not had time to get the information as yet) a great part of the old ignorance and superstition remaining amongst those who have the immediate charge of the cattle as to the cause and effect of the warbles.

So long as there are ideas abroad that warbles are caused by the fresh grass, or that they are humours of the blood, or that, on the other side, they *show* a healthy state of the beast, or *cause* it, because "boils are healthy," so long shall we have half-hearted help or none at all from those in whose hands, literally speaking, the cattle are placed, and as a matter of course, and as may be seen any day at cattle-fairs, those who bring the infested cattle will vouch for the state of hide being rather advantageous than otherwise, and so spread the false theory and practice together.

In this class there is an utter carelessness what happens unless the beast dies, or, if it does die from mortification or other causes connected with the diseased state of the hide, even this is often ascribed to other causes, and till *they* are got to understand *we* must suffer. If, instead of merely looking at the outside of the hide with a minute puncture showing here and there, but otherwise with little sign of disease noticeable, the *inside* could be exhibited just as it is when newly flayed from an infested beast, a very different idea would be given. None who saw the great lumps, with the maggot an inch long, lying and sometimes moving in each, with the shape showing through the thin film to which their own suction and the ulceration caused by it had worn the flesh-side of the hide, the putrid holes where the maggots had burst out in flaying, and in some cases the state of inflammation of this inner surface, could for one instant consider the attack beneficial.

It has been advanced lately that it is the best hides that are attacked by the Warble Fly. Whether this is so or not, it is not in my power to say, as the opinion is not universal; but even if it is so, it appears to be no reason why part of the best hides should be rendered useless.

The point of the attack, however, which all *can* see, and which all concerned look on with unbounded annoyance, is the summer attack of Warble Flies to the cattle in the pastures. Then the loss of flesh on fatting beasts, the loss and injury to quality of milk of the cows, and likewise damage to health in various ways from the animals tearing about as fast as they can go, is a real grievance; and it is this which first of all may be lessened or altogether checked by destroying the maggots in the earlier part of the season.

A great advance has been made in practical application of knowledge lately gained, and in some places where owners have been at the pains to give their herdsmen the requisite information, nothing could

be desired greater than the care taken, and if this same care was spread over the country this time-honoured trouble would be put an end to as far as concerns any serious consequences.*

* For information as to extent and nature of loss, means of prevention, and history of the fly in different stages, with full illustrations, see 'Observations on Warble Fly' and 'Second Report on Warble Fly,' by E. A. Ormerod. Simpkin Marshall & Co., Stationers' Hall Court, London, E.C. Price, 3d. each.

APPENDIX.

Hessian Fly. *Cecidomyia destructor*, Say.

(Continued from page 25.)

DURING the winter further communication has been forwarded regarding Hessian Fly, showing its presence to be more widely distributed than was at first supposed; also regarding observation of the puparia or "flax-seeds" in the siftings beneath the machines; and other information bearing on spread, or prevention of spread, of the attack, of which I give some of the main points, as follows:—

"FLAX-SEEDS" OR PUPARIA.*

On January 17th of the present year (1887) some specimens of Hessian Fly "flax-seeds" were forwarded to me by Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., with the information that he was then finding a good many of them between the blade and stalk on Wheat straw. In reply to my enquiry as to where they were found, Mr. Taylor wrote, on January 22nd:—"I have found them in the stack before being threshed; amongst these the sample sent to you. I have found them on the straw after being threshed; it was on this that I first found them; and since reading your pamphlet I have found them to the number of seven in a small handful of Mustard and other such small seeds, which fall through the sieve, after going over the mill-fanners, and also two sets of dressing-fanners with which our threshing machine is furnished. The two former were Wheat, the latter barley. I at first thought that the pest was only to be found on Wheat grown on light land after Potatoes; but after further observation I find it on Barley grown both on fine light black soil and heavy clay (for we are situated in the centre of the Carse of Gowrie)."

The number of farms in the district on which "flax-seeds" have been reported as observed up to the 24th of February was nine,—eight in the parish in which Daleally is situated, and one about six miles more to the west on the border of Kinfauns parish. The area of the

* As before mentioned, the chrysalis-cases or puparia of the Hessian Fly are called "flax-seeds" from the great resemblance which they bear to this kind of seed both in shape and colour.

farms (where specified by Mr. Taylor) runs from about 160 or 200 acres to 400 acres. Mr. Taylor further communicated, in a copy of a letter sent by him to the 'Dundee Advertiser,' February 1st, that he found the "flax-seeds" on Barley grown both on light and heavy soils, and "pretty thick among Mustard and other small seeds, which fall through the sieve of the fanners below the threshing mill."

The amount of the "flax-seed" found in the siftings has been reported on different inspections as seven in a small handful, twelve in the handful, and "pretty thick" in the small seeds and rubbish beneath the machine,—an amount of pest presence enough to infest the whole neighbourhood.

In regard to this point of the "flax-seeds," that is to say the chrysalids or pupa-cases of the Hessian Fly from the infested straw being found in the fine siftings under the machine, I received a further communication on the 7th of February from Mr. Geo. E. Palmer, of Revell's Hall, near Hertford, who, it will be remembered, was the first observer of the "flax-seeds" being thrown down in the fine siftings, that he has found more or less of these "flax-seeds" present in them on most of the farms "where he has had opportunity for observation in his own neighbourhood." The amount of fifteen in a handful have been found by Mr. Palmer on his own farm.

It is impossible to over-rate the importance of the observations of the "flax-seeds" being thrown amongst the fine siftings as a means of prevention of some portion of the spread of Hessian Fly. There is little trouble and no loss in gathering up the collection of dirt, weed-seed, and insect vermin, and destroying it all in whatever way may be most convenient. In regard to this point, Mr. G. Palmer observed:—"I have taken every precaution, both in destroying the siftings and in treating the infested straw when made into manure in such a manner as to kill any of the pupæ that may have been left in it, *viz.*, by letting it heat in clamps for some time before spreading it on the land. We shall also take care to remove all the straw from the fields early in the spring, so as to prevent the flies from hatching out and laying their eggs on the young Corn when it comes up." If these precautions are taken we shall hold the attack in check, but if precaution is not taken there is great reason, judging by what happens in other countries, to fear severe loss.

"FLY-PROOF" WHEAT.

One of the measures by which it is possible to lessen amount of loss on crop, even where attack takes place, is growing what is called "Fly-proof" Wheat. It may not escape altogether, but by reason of the hard strong stem the fly-maggot makes little way with its injury. This is one advantage; and, secondly, where there is such a stem (either from special kind or from good cultivation) that it continues to

carry the ear well up, instead of falling down at an elbow above the attacked spot, this is an immense saving.

In the experimental ground at the College of Agriculture, California, it was found that in 1886 of 100 kinds of Wheat grown the only kinds that did not suffer were solid-stemmed Wheats. In Canada and the United States various kinds of Wheats are considered to be more or less "Fly-proof," and this point is well worth consideration.

In the Barley on exposed land at Revell's Hall, which I examined, the plant was weak, and it had elbowed down and was seriously injured. The heartier plant on cooler ground had suffered less loss; and recently, relatively to the same points, Mr. D. Taylor wrote me from Errol that enquiry had been made of him by various farmers whether the Fly was likely to do much harm to the crops, as they considered that little difference was distinguishable between what was and what was not attacked. In the instances of the pieces of infested Wheat-straw sent me, this had been firm and strong; and though in one case there were three fine "flax-seeds" nearly at one spot, the straw had not elbowed. Looking at this point in connection with it being considered that much damage was not done, and at the American and German observation that damage is prevented by using Wheat which is strong-stemmed, either by special kind or judicious cultivation, it appears well worth while to consider the matter for practical service. In the words of Dr. Balthasar Wagner, of Fulda:—"Plants grown into stout stalks on rich soil render such a considerable resistance to the attacks of the maggots that most of them will mature their ears. The sparsely-nourished stalks of a field are easily bent." The kind of Wheat that will answer of course will vary according to climate, soil, &c.: one of the kinds, much grown in the Carse of Gowrie, is a reddish Wheat, known as "square" or "club-head"; the other, a white Wheat, of which I have not yet got the name.

The points mainly to be attended to at present to prevent spread of attack, or great damage if it comes, are to destroy all "flax-seeds" in screenings, and so treat the infested straw as mentioned above, and, in the circulars and pamphlet by Mr. Whitehead, that the pest in them may be destroyed; likewise by all means possible to procure a hearty, sturdy stalk;—and also to bear in mind that as this attack only, as far as is known, affects Wheat, Barley, and Rye; that growth of Oats amongst the Cereals, or any of the crops included under the head of roots, as Turnips, Mangolds, Potatoes, &c.; any pulse crops, as Peas, &c., or any crop, such as Cabbage, Mustard, Flax, or ground or bush fruits, would be safe from any damage from Hessian Fly, and beneficial to the country by giving a total check to possibility of spread of this noxious pest on the area so occupied.

RATE OF SPREAD OF HESSIAN FLY.

In Russia the Hessian Fly is very injurious ; and I am favoured by the kind permission of Dr. K. Lindeman, Professor in the Academie Agricole of Moscow, Russia, who was the first discoverer of its presence in that country, to offer the following extract from communications he has lately been good enough to send to myself, and which I give in detail, as the testimony to such enormous powers of spread, from Dr. Lindeman's own knowledge, is exceedingly instructive in our present trouble. Dr. K. Lindeman wrote, during February last :—"The *Cecidomyia destructor* was discovered by myself first in Russia, in the Government of Poltowa, in July, in 1879. Since then I have myself studied it in many parts of the country, and received puparia from very many correspondents, and up to the present time I am aware of the presence of this injurious insect in the following Governments :—Bessarabia, Vladimir, Vologda, Vollynia, Voronetz ; in the country of the Don Cossacks, Ekaterinoslav, Kazan, Kaluga, Kiev, Kostroma ; in the country of the Kuban Cossacks, Kursk. Mohilev, Moscow, Nischny-Novgorod, Novgorod, Orel, Penza, Podolia, Poltowa, Pskov, Perm, Riazan, Samara, Saratov, Simbirsk, Smolensk, Stavropol, Tambov, Tula, Kharkov, Kherson, Tschernigoff, Estland, Jaroslav, and beyond the Ural Moutains the Hessian Fly occurs in the district of Schadrinsk (Government of Perm). In this wide extent of territory the Hessian Fly causes with us yearly very severe injury, which rises to a great height, especially in Southern and Mid-Russia."

It will be observed from the above details that in the course of eight years, from the first observation of its presence, this crop-scurge has spread over an area of country extending from the more northerly parts of Russia to the shores of the Black Sea, which may be generally described as a square length and breadth, exceeding in some parts twice the length of England and Scotland taken together. *Unless timely precaution is taken here, the above note shows what we have to fear.*

The point still remains to be found out,—Where does Hessian Fly come from ? It is most likely that it is imported in straw or in Corn not cleared of the fine rubbish and weed-seeds, which have to be cleared out in this country if the Corn has not been thoroughly cleaned before shipment. We can only learn whence it comes by careful watching. It is exceedingly desirable that all who use imported straw, either for litter or bedding, or for fodder, would, as a regular thing, see if it contained "flax-seeds." Splitting open a sheathing-leaf at the second joint of the stem here and there amongst Wheat or Barley straw when known to be imported, would help greatly towards knowing if the pest

was present, and a small *bonus* promised to the farm men (whose business especially brings the straw through their hands daily), to be given on discovery and production of infested specimens, would ensure a good watch. A formal inspection in the stores might very likely give no results, and would require the baled straw to be loosed; but a watch kept on the straw, also on slightly-used litter and on long manure, would be well worth while. A watch on screenings from imported Wheat and Barley is also highly desirable.

“FLAX-SEEDS” IN LIGHT CORN OR “SHAG.”

March 12th, 1887.—Whilst the above pages have been passing through the press further discoveries have been made of the place of deposit (during threshing infested straw) of the chrysalis-cases or “flax-seeds” of Hessian Fly, which bear very importantly on the subject, of means of spread, or methods of prevention of attack.

During the last few days I have received information from Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., that he not only finds the “flax-seeds,” as before mentioned, in the “siftings,” but that they were still more easily observable “in the light grain or ‘shag’ which fell immediately behind the dressing-fanners, or is delivered at the side by a ‘shag’ or tail-spout, also amongst the earth and small weed-seeds which fall through the sieve below the fanners.”

The proportion of “flax-seed” to the handful was found to be much larger in this light corn or “shag” than in the siftings. In these the amount of “flax-seed” ran to about twelve to fifteen to the handful, but in the light corn as many as nearly forty to the handful were found, and in a four-gill measure of light grain, as it came from behind the dressing-fanners, Mr. Taylor found “*some few over ninety.*”

This discovery, which, it should be remarked, is from an observer perfectly cognizant with appearance of the puparia, is of grave importance. It not only shows how attack may be reinstituted from our own threshings on to our own fields, and therefore that every farmer through the country should be on the alert, both on his own land and in his own neighbourhood, in bringing about clearing of the “flax-seeds” from the light corn, and destruction of the same by all means in his power, but further, it points to how attack may come in foul imported grain. Where this is sent to us uncleaned from infested countries there is fullest likelihood of Hessian Fly “flax-seeds” being transported amongst the weed-seed and small rubbish, and those who buy cheap screenings should be alive to the fact.

Eelworms. *Tylenchus devastatrix*, Kuhn.

(Continued from page 47.)

"TULIP-ROOT" IN OATS.

In the case of Tulip-root attack it is of great importance to know what is the precise kind of Eelworm which causes the disease, because, as previously mentioned (p. 87), there are some kinds which are so very long-lived that they may remain in the land for years, and thus be ready to infest any crop put in that may suit them.

It is now in my power, through the able assistance most kindly granted me, to state that the kind of Eelworm present in specimens of our English Tulip-root disease in Oat plants has been found to be the *Tylenchus devastatrix* of Kuhn, formerly known as the *Tylenchus dipsaci*, Kuhn, but of which it was considered desirable to change the special name, on account of the variety of crops which it has been found to *devastate* or greatly injure, instead of being more particularly hurtful (as was formerly supposed) to the Teazel (*Dipsacus fullonum*), whence its specific name of *dipsaci*.

I beg to acknowledge with many thanks my obligation for the following notes to the information kindly given me by the eminently well-skilled observers, Dr. J. G. de Man, Middleburg, Netherlands, late Conservator of the Museum, Leyden; * and Dr. J. Ritzema Bos, Professor of Zoology at the Agricultural College, Wageningen, Netherlands, who has studied this Eelworm disease for many years, and has written upon the subject, with valuable details of his own experiments, and is shortly about to publish a Monograph on this and on other species of Eelworms (*Nematodes*) injurious to crops.

It appears that this disease was first observed on Rye, and the name of Stock-krankheit, or more shortly "Stock" (which may be translated stem-sickness, or more shortly the "Stem") was bestowed upon it; and afterwards the same species of Eelworm was found to cause the "Stem" also in Oat plants. The above term draws attention much in the same way as our own term of Tulip-root to the nature of the attack affecting the development of the stem. As in the middle of the winter there is much difficulty in procuring fresh specimens, I could only offer for investigation young plants of winter Oats from the infested field, mentioned at p. 48, and also some stubble from the field marked 1886 in the plan given at p. 42; but although the diseased growth was only just slightly showing as yet in the former, Dr. Ritzema Bos found therein specimens which he determined as being certainly the *Tylenchus devastatrix*, Kuhn, a few of them being fully developed.

* Author of the work on Anguillulidæ, entitled, 'Die frei in der reinen erde und in süssen wasser lebenden Nematoden der Niederländischen Fauna.' 84 plates.

In the dead part of the stubble from Arniston mains only a few *Tylenchus devastatrix* were present, it being a habit of these Eelworms (as far as has been observed in Rye) to leave the dying plant; but Dr. Ritzema Bos "found this species in somewhat greater numbers in the young shoots that were springing from the haulm of the Oat stubble, which were still alive and green. *All these were without doubt Tylenchus devastatrix.*" Other Anguillulidæ, or Eelworms, were present in the dead part of the plants, or in the earth hanging about them, belonging to the genera *Diplogaster*, *Cephalobus*, *Rhabditis*, *Mononchus*, *Plectus*, and *Dorylaimus*, of which Dr. J. R. Bos observes that "all these live in humus or in earth, and are not plant parasites, and cannot possibly be the cause of Tulip-root disease."

Further I may add that early in the correspondence I forwarded a few plants remaining to me of specimens of last season's Tulip-root, then quite dried up, to Dr. J. G. de Man, who was so good as to examine them, and pronounced that he found specimens therein of *Tylenchus*, which he considered to be *Tylenchus devastatrix*, Kuhn, but these being dead, and not sexually developed, he could not speak with absolute certainty of the species; but later, in a few specimens of Tulip-root from the same packet, above alluded to (from field mentioned at p. 42), Dr. de Man found a perfectly developed male of the *Tylenchus devastatrix*, Kuhn. From the fact of this species of Eelworm being found in our English "Tulip-rooted" Oat plant, as well as in the German similarly diseased plants, there is now no reason to doubt that this, namely, the *Tylenchus devastatrix*, Kuhn, is the cause of the attack.

The *T. devastatrix* is considered to be the only species of Eelworm that causes Tulip-root,* but many other kinds are often present, either in or amongst the sheathing-leaves or the roots of the Oat plants. As it is impossible for any but those who have long and minutely studied the subject, and also are aided by strong microscopic power, to determine the differences between these kinds correctly, I do not give the descriptions; but having been so greatly favoured by Dr. de Man as to receive from him a list of the different species which he found present, in or accompanying the Oat plants I forwarded to him, I, with his kind permission, give this information, as it will be of much interest to students of the subject before passing on to means of prevention of Tulip-root. Dr. de Man wrote to me:—"I have found *Cephalobus rigidus*, Schneider, which is identical with *Cephalobus oxyuris*, Bütsche,

* For description and figure of the *Tylenchus devastatrix*, by Dr. Kuhn, see 'Zeitschrift für wissenschaftliche Zoologie,' T. ix., p. 129, plate vii. c. Likewise, by the same author, 'Die krankheiten der Kulturgewächse,' Berlin, 1858, p. 179, and plate v. It is also described in Dr. H. Charlton Bastian's "Monograph of the Anguillulidæ," vol. xxv. of the 'Trans. of Linnean Soc.,' p. 128.

very frequently at the base of the stem on the inner side of the delicate sheaths by which the stem is surrounded. This species was not yet known as occurring in England. On these sheaths I also observed some specimens of *Aphelenchus modestus*, de Man, both male and female; and the following species were moreover found, though some of them probably occurred in the adhering earth:—*Monohystera simplex*, de Man; *Mononchus papillatus*, Bastian; *Mononchus bidentatus*, de Man; *Cephalobus striatus*, Bastian; *Plectus granulosus*, Bastian (see fig. 8, p. 86 of this report); and *P. cirrhatus*, Bastian."

With regard to the three species figured (from Dr. Bastian's Monograph at page 86, to give some idea of differences of structure in various kinds of Eelworms), Dr. de Man mentions that he "had found *Plectus granulosus* to be one of the commonest species, living in the soil, and distributed throughout the whole of Western Europe." "*Tylenchus obtusus* is most closely allied to *T. dubius*; the latter species, however, is nearly as common, and as widely distributed" in the soil as the *Plectus granulosus*. "*Aphelenchus avena*, however, hitherto was never," Dr. de Man observes, "found by me in the soil, and I presume that it inhabits the plants without causing a disease."

The following notes give some additional information as to methods of prevention and habits of this Eelworm, with which I have been favoured by Dr. J. Ritzema Bos:—

"As soon as the 'stem-sick' Rye begins to die, and the haulm to turn yellow (as during the ripening of the Corn, but often much earlier), the *Tylenchi* begin to wander from the upper to the lower parts of the plants, to finally leave the plants and live in the ground (usually in a state of suspended animation). Thus the *Tylenchi* begin to travel directly the plants begin to die, and much sooner. But directly the plants are entirely dead, or dried up, the *Tylenchi* cannot travel farther, because they pass into a state of torpidity in the dried tissues. Thus, because during the ripening of the Rye and the withering of the plants, most of the *Tylenchi* wander from them into the earth, the earth thus becomes infested. But as *all* the *Tylenchi* have not been able to leave the plants before the complete withering or ripening, the straw and also the stubble will always contain a greater or less amount of these Eelworms, more especially as during the ripening of the Rye eggs of this Eelworm are still to be found in it, which of course cannot wander away."—J. R. B.

Therefore, as is pointed out by the Professor Dr. J. Ritzema Bos, above quoted, the stubble cannot be ploughed in without danger, because there is still presence of Eelworms in it; and if it is burnt directly the crop is cut, though we get rid of those that are in the stubble, there are still the great number which have travelled into the

ground remaining. This attack is most difficult to deal with when once established. It is most easily carried out to the land in small quantities, as mentioned at p. 46, and establishes itself in patches, as seen in the map. If such patches are ploughed across, or indeed if they are left alone, the Eelworms spread thence and gradually get hold; and, as before mentioned, attack Oats, Rye, Buckwheat, Clover, and Teazels amongst common crops, and Wild Teazel and Corn Blue-bottle amongst weeds. It is also mentioned as infesting the two common grasses,—*Anthoxanthum odoratum*, or Sweet-scented Vernal-grass; and the *Poa annua*, or Annual Meadow-grass; and the common Buttercup, or creeping Crowfoot (*Ranunculus repens*), which may prove to be a reason for attack being found on broken up grass-land; likewise the Ribwort Plantain (*Plantago lanceolata*); the *Polygonum convolvulus*, which is nearly allied to Buckwheat; and also Spurrey. And further, from experiments carefully tried, there seems no reason to doubt that it also infests Onions; and as decayed Onions are commonly wheeled out to the farm rubbish-heap, this circumstance may turn out to be the reason of the little patches of attack sometimes noticeable.

It is probable that a dressing of fresh gas-lime put on the patches so thickly that it would kill the "wormlets," and everything that was there or was put in for months after, would be the best treatment where merely small patches are found in clean ground; the little bits of land could be spared, and the centres of infection thus probably totally destroyed. Enormously deep ploughing or trenching, as mentioned at p. 46, is of use, because it puts the Eelworm down where it will die; but the remedy is very difficult to carry out, both on account of its expense and of bringing up unimproved soil to the surface.

After long search in special works on the subject, and the benefit of special consultation, it appears to me that the main points to be attended to are:—1st, Carefully to avoid spreading the infection, either in infested litter, common farm manure, or dung, as it appears that the wormlets may be passed through the cattle without injury. 2ndly, To avoid spreading it by means of infested earth carried in any way about an infested field, or from one field to another; but that the only thing really to be trusted to in case of attack is to exclude crops subject to this Eelworm (which are mentioned above, and in the preceding paper at p. 46) from the rotation till the land is again clean.

LIST OF CONTRIBUTORS

TO

REPORT ON MUSTARD BEETLES (pp. 58—76).

ABBOTT, W., Serpentine House, Wisbeach.
BANNESTER, A., Barling, Rochford, Essex.
BRAND, T. P., Foxearth, Long Melford, Suffolk.
CASWELL, C., Peterborough.
CATLING, Capt. R. C., Needham Hall, near Wisbeach.
EGAN, S., Wryde House, Thorney, Peterborough.
FREEMAN, J. W., Dadlington, Hinckley, Leicestershire.
FULLER, A., Ramsey, Hunts.
GREEN, W. W., Manea, Cambs.
HARRINGTON, A., Rochford, Essex.
HARVEY, C. C., Foulness, Great Wackerling, Essex.
JAQUES, T. E., Blacktoft, Howden, Yorks.
LITTLE, Professor H. J., Coldham Hall, near Wisbeach.
LITTLE, W. C., Stags Holt, March, Cambs.
LOWE, RALPH, Sleaford, Lincolnshire.
LUDDINGTON, J. L., Littleport, near Ely.
MEESON, W. M., Battles Bridge, Essex.
MOORE, GEO., Redmoor, Elm, near Wisbeach.
REED, Col. LANCELOT, Elm, near Wisbeach.
SEARS, R. H., Manea, Cambs.
SMITH, E., Southminster, Maldon, Essex.
TIBBETTS, J., Asham House, Doddington.

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*of E. J. Mickson, College of Agriculture,
California.*
With compliments from the writer

REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS

AND
COMMON FARM PESTS

DURING THE YEAR 1887,

WITH METHODS OF
PREVENTION AND REMEDY.

ELEVENTH REPORT.

BY

ELEANOR A. ORMEROD, F. R. MET. SOC., &C.,

CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY; HON. AND CORR. MEM.
OF ROYAL AG. AND HORT. SOC., S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO,
AND CORR. MEMBER OF FIELD NAT. CLUB OF OTTAWA, CANADA; MEMBER
OF EASTERN PROVINCE NATURALISTS' SOC., CAPE COLONY, &C.

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PREFACE.

DURING the past season of 1887 the prolonged heat and drought was accompanied by an unusual amount of presence of various kinds of crop-insects, and also by unusual amount of damage from them.

The attacks of insects injurious to corn-stems were, as is well known, unusually severe. The old-standing attacks of the Barley *Chlorops* and the Corn Sawfly were so prevalent as to be often mistaken for those of new pests, and the new arrival, the Hessian Fly, showed spread over a far wider area than in the previous year; and though it caused little damage to Wheat, was injurious in some cases to a serious extent to Barley. Turnip crops also suffered much, especially from Turnip caterpillar, and from Aphides, commonly known as "blight."

Amongst attacks injurious in fruit farming, which is an increasingly important subject, that of the Pear "Slug-worm," the maggot of a sawfly, was unusually observed, and so was the Black Currant *Phytoptus*, a minute mite, which does much harm to this kind of Currant, and when once established is very hard to get rid of.

Great advance has been made with regard to some of the regular annual causes of loss, either by directly lessening amount of attack or by increase of knowledge, both as to the habits of the insect and methods of treatment reliably available for lessening the evil, which would be exceedingly useful if the knowledge could be more generally spread.

The destruction of Ox Warble has been especially shown (by the widespread observations of last season following on those of the preceding years) to be a matter easily and cheaply carried out, with great benefit to cattle-owners.

The careful experiments as to the cause of true Clover "Sickness" (as distinguished from disease caused by fungus; maggots at the root; decay at the top; non-thriving from state of soil, &c.) have proved this disease to be so constantly connected with presence of a special kind of "Eelworm" as to make it appear that this *Tylenchus devastatrix* is the cause of this so-called "Sickness." Reports of observations regarding this Eelworm are given under the heads of "Clover Sickness," and of "Tulip-root" in Oats, and show, amongst other points, the facility with which plants of kinds liable to infestation may receive it by being sown over infested remains.

The proof of the migration of Hop Aphis, to and fro, in spring and autumn, between Hop and Plum of various kinds, is very important to Hop growers, because this point, although commonly believed to be the case, was not so certainly known before, especially with regard to the autumn migration; and the new observations made by Prof. Riley whilst in England, on this latter point, open up one certain way towards lessening amount of Hop Aphis.

The means of prevention of the great amount of injury caused to orchard foliage in the spring by the "Looper" caterpillars of the "Winter Moth" have been further experimented with, and the simple measure of putting a band of sticky material round the base of the trees, in previously infested orchards (so as to prevent the wingless female moths creeping up to lay their eggs in early winter), has been confirmed as successful.*

Various communications have been placed in my hands regarding the Sparrow nuisance, but I have not entered on the subject here, as I trust very soon to be able to bring forward the special points calling for grave consideration more effectually than I could do in my own Report.

Other details and notes of attack are given under their respective headings, and, together with these, I have expressed my thanks and acknowledgments to the kind contributors to

* Whilst this report was passing through press I received information from Mr. Robert Mercer, of Rodmeraham House, near Sittingbourne, regarding the above point:—"I have followed your advice in using Davidson's Composition, and all through the month of November the belt of mixture at the bottom of the trees was almost covered with the moths."

whom I am indebted for much information, and in some instances for a great deal of trouble ungrudgingly taken both in observation and reporting results. But I should especially acknowledge the valuable aid given by Dr. Ch. Lindeman, Professor at the School of Agriculture, Moscow, in identifying specimens of our British parasites of the Hessian Fly, and in presenting me with type specimens of Russian species for British service. Likewise I am much indebted to Prof. Riley, Entomologist of the Department of Agriculture, U.S.A., not only for his valuable help with regard to the Hessian Fly parasites, but also for much serviceable information on Hop Aphis, and other points communicated both by letter and personally during his stay in England.

To Dr. J. G. de Man, of Middleburg, and to Dr. J. Ritzema Bos, Professor of Zoology at the Royal Agricultural College, Wageningen, Netherlands, I am under great obligations for their skilled assistance, most kindly given in successive examinations during several months relatively to infestation of crops by *Tylenchus devastatrix*; and I cannot omit acknowledgment of communication and also of aid whenever sought from my valued friends, Mr. J. Fletcher, Entomologist to the Dominion, and Prof. W. Saunders, Director of the Government Experimental Farm Stations, Canada, and Mr. Frazer S. Crawford, Inspector under the Vine, &c., Protection Act at Adelaide, South Australia, and also the long labours of my sister, Miss G. E. Ormerod, in translation of German and Spanish Entomological papers, whereby she saved me much loss of time in reference.

I must also acknowledge, with many thanks, the aid given to the subject of prevention of injurious insects by the Press, and especially by the Editors of our leading Agricultural Journals.

The illustrations in the present Report are in some instances from my own drawings, in some from other sources acknowledged together with the figure, and for others (as before) I am indebted to the courtesy of Messrs. Blackie and Son, Glasgow. The crop attacks and those to animals are placed in two divisions, not classed together alphabetically. In the coming season I shall be glad to receive any information bearing on serviceable methods of prevention of farm pests, and to reply to any inquiries to the best of my power, and I desire to draw the

attention of my correspondents and contributors to my change of residence, together with my sister, to St. Alban's, having placed me in a much more favourable position, both for personal communication with those who may wish to consult me, and also for field investigation, than was the case in the immediate neighbourhood of London; and I trust now to be able to carry on more personal examination as to the state of farm pests in the field.

ELEANOR A. ORMEROD,

*Consulting Entomologist of the Royal Agricultural
Society of England.*

TORRINGTON HOUSE, ST. ALBAN'S,
March, 1888.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS

DURING 1887.

CLOVER.

**Clover-sickness caused by Eelworms. *Tylenchus devastatrix*,
Kuhn.**

During the investigations in 1886 as to the cause of the diseased growth known as "Tulip-root" in Oats, there seemed reason for supposing that the same kind of very minute Eelworms which are the cause of this Oat disease were also the cause of the disease known as "Clover-sickness." This kind of Eelworm (scientifically, the *Tylenchus devastatrix*) attacks a very large number of different kinds of plants, including various kinds of bulbs and grasses, and common meadow and field plants, besides various kinds of corn and cultivated crops; and, from the widespread ravages, the special name has been changed in the last few years from the *Tylenchus dipsaci*, or "Teazle *Tylenchus*," to the *T. devastatrix*, alluding to the "devastations" it sometimes gives rise to.

These *Tylenchi* are excessively minute Eelworms (of the same nature, though not the same habits, as Paste Eelworms), but so small that they cannot be distinguished at all without strong magnifiers, about the 24th of an inch long, and they are to be found as male, female, undeveloped young, and eggs, sometimes in vast numbers, in the attacked plants.

As disease in Clover arises from many different causes, as frost, fungi, &c., it is right to specify that the following observations about *Tylenchus* presence are only meant to refer to cases of the disease

known as "Clover-sickness." There are many kinds of Eelworms, some of which live in earth or decayed matter, or are found outside young corn plants beneath the sheathing-leaves; but the *Tylenchus* under consideration attacks and lives by suction on the growing plant, and causes decay and death in some cases, and in some its presence is shown by a bulbous or deformed growth of the base of the corn plant, or the shoots attacked.

As it is totally impossible for any one to offer a trustworthy opinion as to the kind of Eelworm present, excepting those who have devoted especial attention to the study of the Nematoid worms, I examined as well as I could myself, but also I forwarded specimens to the Netherlands to the skilled examination of Dr. J. G. de Man, of Middleburg, and Dr. J. Ritzema Bos, Professor of Zoology at the Royal Agricultural College, Wageningen, well known for their special attention to this class of pests, and publications thereon; and I acknowledge with many thanks not only the courteous help they have given me by examination of many consignments of specimens, but also the permission to publish, in my own Report, their valuable information.

My first observations on "Clover-sickness" were taken about the end of March, when I received specimens of Clover-sick plants from Mr. Manfred Biddell, of Playford, near Ipswich, with the remark that he had very little of the disease this year. On examination of these plants Dr. Ritzema Bos informed me that he found *Tylenchi* in the short yellowish stems, and certainly eggs, larvæ, and full-grown males, but not full-grown females; but from inspection of the males it was clear, and without doubt, that they were *Tylenchus devastatrix*, and that all appearances showed the cause of "Clover-sickness" to be due to the same kind of *Tylenchus* as that which causes "Tulip-root" in Oats. Other Eelworms were present in the diseased Clover, but these Dr. R. Bos found only in the brown withering parts, and considered that "these so-called *Humus-Anguillula* were certainly not the cause of the 'Clover-sickness.'"

On April 22nd Mr. Biddell sent me a further supply of Clover plants for inspection, with the note that "there are in this neighbourhood fewer so affected than usual. The plants first affected are now quite withered away, and will not hold together, but some are sent in all stages that could be found."

Of these Dr. R. Bos reported that he could not find a single *Tylenchus* therein, but found the mycelium of a fungus. Of this fungus Dr. Bos gave some details and observations, but, this being outside my own department, I do not enter on the subject here.

On April 12th Miss M. Curtis Hayward, writing from the Manor Farm, Quedgley, near Gloucester, mentioned that "a piece of Clover

on our farm here is failing in small patches. . . . The piece is looking well altogether, but here and there a plant has entirely died away and the root rotted." Miss Curtis Hayward mentioned that the disease or injury did not appear to be always from the wet ground, as though the Clover had failed in a large patch in a wet place, yet also single plants had gone all over where they were on rising spots of higher ground than the plants around them, which remained green and flourishing.

Dr. Ritzema Bos also replied that he could not find any *Tylenchi* in the Clover plants sent from Gloucester. These Clover plants were in some instances so completely rotted across the stems that the shoot or shoots broke off on being moistened. The leaves at the top of the plants were perishing. I found a few *Anguillulidæ* present in the decayed matter.

On examination of specimens of these plants Dr. J. G. de Man replied to me, on April 14th, that he was inclined to consider a species of fungus as the cause of the disease, and in most of the plants he found, on special examination, myriads of small fungus spores. He mentioned that the *Anguillulidæ*, which were present in very small numbers, were the *Aphelenchus modestus*, and could not be the cause of the disease, because their number was too small.

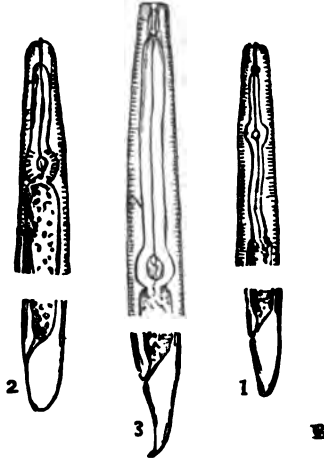
Dr. de Man observed, on April 25th, regarding the plants "supposed to be 'Clover-sick' that you received from Quedgely, near Gloucester, I did not observe any abnormality in them, so that I conclude that they were healthy. I found a few Eelworms in them, all wrinkled and dried up, belonging to *Plectus cirratus*, Bast., *Aphelenchus modestus*, and a species of *Cephalobus*; but they were innocuous in this case. I still may remark that these plants all may be killed by frost, and that frost also may be the cause of the disease of these plants. Perhaps the Gloucester plants have suffered from it."

The figure on the following page, in which the head and tail of three kinds of Eelworm are represented as transparent objects, is added to give some idea of the different internal structure of species of three of the genera mentioned.

In some of the above cases it was not clear that the plants were attacked by true "Clover-sickness," and, as it was of much importance in the investigation to have Clover plants which were not simply diseased, but were suffering under the precise and special form known as "Clover-sickness," I was furnished, on April 20th, with some good characteristic specimens by Mr. C. Whitehead, of Barming House, near Maidstone, with the following note:—

"I send you a box of capital specimens of Clover-sick plants from a 'coomby soil' between the chalk and the greensand in Kent. . . . The roots seem unaffected. The disorder appears to begin just at the

top of the root-stem and crown. The tissues above this and up to the ends of the leaves are disorganised."



ANGUILLULIDÆ.

1, *Tylenchus obtusus*; 2, *Aphelenchus avenae*; 3, *Plectus granulosus* (of Bastian); all enormously magnified.

Some of these specimens I sent, by kind permission, to Dr. J. G. de Man, and also to Dr. Ritzema Bos; and, on April 25th, Dr. de Man replied that he had examined the plants with the following results, to which I particularly desire to draw attention:—

"The Clover plants that you received from Mr. Whitehead, of Barming House, near Maidstone, Kent, were indeed diseased, and *Tylenchus devastatrix* ought to be regarded in this case as the cause of the disease. I found the interior of one stem decayed and containing a number of living specimens of *T. devastatrix*, both male and female, young individuals, and innumerable eggs. I have studied some specimens, and I have taken exact dimensions of them. So I found that both the male and female attain to a size of 1·5 mm.; the tail measures in both 1-15th to 1-16th of the whole length; the 'œsophagus' measures 1-7th to 1-6th of the whole length; and the 'spear' in the head has a length of 0·018 mm. All these dimensions perfectly agree with the original description of Kuhn, so that these specimens positively are representatives of *devastatrix*.

"In two stems I found again the fungus spores, on which I have already written to you. The occurrence of the fungus in this case may be either independent of the *Tylenchus*, or perhaps the fungus attacks the plants after having been infested by Eelworms. I cannot decide this question.

"Sometimes I observed a few specimens of an *Aphelenchus modestus*, but these are not the cause of the disease in this case.

"I will add that the fungus spores are oval, and are 0.005 to 0.006 mm. long. The eggs of *T. devastatrix* are also oval, and are 0.07 to 0.08 mm. long."

On April 25th Dr. Bos wrote me that in the plants I sent him on the 20th inst. out of Kent (of which I wrote that they were certainly true specimens of the state of disease known as "Clover-sickness"), he found several *Tylenchi*, male, female, and eggs. "The short branches were irregularly thickened, and, in short, these Clover plants showed the greatest resemblance possible in their condition to that of other attacked plants which I know to have been caused by *Tylenchus devastatrix*." Dr. R. Bos mentioned that he found in the "sick" plants, and especially in the decaying parts, a few Eelworms of other kinds, but these were in such small numbers that there could be no doubt as to which were the origin of the "Clover-sickness."

On April 29th Mr. Whitehead wrote me, from Barming, that he had forwarded fresh specimens of "Clover-sick" plants, in which he considered he himself could discern the *Tylenchi*, to Dr. Ritzema Bos, who, after examination, sent him the following reply, which I am permitted to insert:—

"I have yesterday received your packet with Clover-sick plants, and I have found in them, especially in the tops of the branches and the buds, a great quantity of the males, females, larvæ, and eggs of *Tylenchus devastatrix*, the same Nematoid worm which is the cause of the 'Stockkrankheit' of the Rye and Buckwheat in Germany and the Netherlands, and very probably of the Tulip-root in Oats. You will oblige me very much by informing me whether the foregoing crop was Tulip-rooted Oats. Miss Ormerod has sent me Clover plants (Clover-sick) from land where previous Oat crop was destroyed by Tulip-root, and I found a great quantity of *Tylenchi* in them."

In the course of the latter part of April and beginning of May Mr. John Elder, of The Holmes, Uphall, Linlithgowshire, forwarded me specimens of Clover plants which he had noticed were not thriving when he was top-dressing the field a fortnight before. "They were worst on the portions which failed through Tulip-root last year when in Oats."

The mixture applied was sulphate of ammonia, four parts; steamed bones, two parts; sulphate of potash, one part. One and a half cwt. of the mixture per acre.

Specimens of these were forwarded to Dr. Ritzema Bos, in some of which he found decided infestation. Dr. Bos wrote me:—"In Nos. 8 and 4 I found *Tylenchi* in a considerable number; males and females, larvæ and eggs. In No. 8 I found a great number of *Tylenchi* in the

lower part of a branch of a Clover plant, which in the centre was dying also in the infested buds. In No. 4 I found them in the inflated buds only."

(The plants marked No. 8 were noted by Mr. Elder as "unhealthy plants grown on undrained land at the end of field, after Oats destroyed by Tulip-root. Oats after Turnips manured with farmyard manure" and those marked No. 4 were "unhealthy plants grown on land not very well drained, where preceding Oat crop was destroyed by Tulip-root." Oats after Turnips, town manure, consisting principally of ashes and farmyard manure.)

Other specimens were subsequently sent by Mr. Elder, in commenting on which Dr. R. Bos made the following remarks:—"I think it to be evident that this form of 'Clover-sickness,' 'Tulip-root' in Oats, the 'Stem-disease' in the Rye, the 'Ring-disease' in Hyacintha, &c., are all caused by the same parasitic Nematoid worm, *Tylenchus devastatrix*, for the worms found by me, sometimes in a large number, in the Clover plants were *T. devastatrix*; those found by me in Tulip-rooted Oats were *T. devastatrix*; and in Clover-sick plants grown on land where previous crops were Tulip-rooted Oats I found often the same parasite. In the plants of Mr. Elder, which were *not* grown on land where Tulip-rooted Oats had been the previous year, I found *no Tylenchi*."*

On July 8th specimens of diseased Clover plants were forwarded to me from the Experimental Farm, Woburn, by Mr. F. E. Fraser, in which the peculiar bulb-like deformation of the attacked bud or shoot, which often characterises *Tylenchus* attack, was very noticeable. Mr. Fraser mentioned that the ground from which these plants were taken was exceedingly hard, as there had not been any rain for the previous month.

On examining the specimens of Clover some of the stems with flowering heads were still to be found, but also there were a large number of short brown barren shoots about an inch long, oval in shape, and with the distorted growth of leaves now merely forming an imbricated or tile-like exterior. These shoots were placed closely together, apparently from the growth of the shoot having been stopped. They varied in number; sometimes as many as five grew on an inch length of shoot, one at the extremity and two at each side below, so as to form together a flat fan-like mass. I did not find they grew round the central stem. They were not all similar in form of diseased growth, but were commonly irregularly and oval or somewhat bulb-shaped, but sometimes they were much prolonged, so as to resemble what is known as a duck-necked onion in shape, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base.

* For further communications by Mr. Elder on Eelworms, see paper on "Tulip-root" on Oats.

In some instances the short brown deformed shoots had a little bit of deformed shoot or of leaf-growth proceeding from it. One of the shoots, which was merely swollen, not altogether shortened by disease, on being opened, proved hollow near the base, with decayed matter within, and also palish-brown powdery or rather damp granular matter; and, on placing this under an inch-power, it proved to be swarming with *Anguillulidæ*. Under a quarter-inch I clearly distinguished in some of these the presence of a spear with bulbous base. I also found *Anguillulidæ* in the short, brown, somewhat bulbous-like shoots, in the perishing matter in the centre of the short somewhat scale-like leaves.

On forwarding specimens to Dr. de Man for his skilled investigation, he replied :—" I have examined the Clover plants that you have sent me, and most plants, if not all, were found to be infested by numerous *Tylenchus devastatrix*, so that the occurrence of this dangerous worm ought to be regarded as the cause of the disease."

Dr. Ritzema Bos also replied :—" In the Clover-sick plants I have examined the deformations you so correctly describe, and I found *T. devastatrix* in them."

Dr. Ritzema Bos added the following information, which is well worth observation, as showing how plants completely different in kind, but all subject to attack of this kind of Eelworm, can both receive and convey the attack to each other :—

" I had sown some time ago Onions in sand, mixed respectively with Tulip-rooted Oats, Clover-sick plants, and Carnations, attacked by *Tylenchi*; and I found that the *Tylenchi* of each of these diseased plants attacked the Onions, and made them diseased in the same manner as the *Tylenchus* disease with which we are acquainted in the Netherlands; and, in sand mixed with decaying Clover-sick plants and diseased Onions, I sowed Oats, and soon the Oats became Tulip-rooted. Thus I have shown that not only morphologically, but also physiologically, there is no specific difference between the *Tylenchi* in Clover-sick plants, in Tulip-rooted Oats, in 'Pine-apple' diseased Carnations,* and in diseased Onions."

* "Pine-apple" diseased Carnations.—This peculiar form of growth had been so marked in some specimens of diseased Carnations which I had recently forwarded to Dr. Ritzema Bos, that I had suggested this name as convenient for describing the appearance of Carnations attacked by *T. devastatrix*, just as the word "Tulip-root" is used to describe Oats with this outward manifestation of presence of this Eelworm. It may be of interest further on to mention that in my own experiments as to infestation I sowed Turnips over Tulip-rooted Oats, torn small and buried in the soil, into which the seedling Turnips presently shot; and, on submitting these to Dr. de Man, he found one Turnip was infested with the *Tylenchus devastatrix*, but I was not able to continue my experiments on account of being then removing to a new home.—ED.

From the above investigations it appears that, though disease and decay occur in Clover from many causes, in the various cases examined into, where there was true "Clover-sickness," there also was to be found the presence of this particular kind of Eelworm, the *Tylenchus devastatrix*; and, in the cases of disease so advanced as to have a marked state of deformity of growth, there the Eelworms were markedly present.

From various circumstances—and, amongst these, especially from the suitable nature of the soil to the plant—it is possible for Clover to go on growing year after year on the same land, and still to thrive; but if the Eelworms are once established in land there is difficulty in clearing them, because not only of their immensely long-livedness, which extends over a period of several years, but also that they have the power of leaving infested plants and remaining in the field-earth; and further, that the one kind under consideration infests a very large number of crop and weed plants.

This puts treatment of this attack under different principles to that of most insect attacks, for the application of ordinary chemical manures will do good by killing the Eelworms frequenting the surface of the soil, even though these manures may not be what are more especially and technically, so to say, used for Clover.

As far as one experiment can show, that detailed above of the application of a top-dressing of sulphate of ammonia, sulphate of potash, and steamed bones did well, this being followed up by 2 cwt. per acre of sulphate of ammonia. In this case the result was so luxuriant a growth that in a little more than a fortnight after the second dressing the unhealthy plants (if any remained) had ceased to be noticeable. The fact of the land under consideration being deficient in potash may have to do in this instance with the addition of potash, mixed with other manure, being of marked service, as noted by Mr. Elder also in the case of Tulip-root in Oats; and, if a manure can be chosen at once pernicious to the Eelworms and beneficial to the Clover, this would be highly important.

It appears, so far as I can judge, a case in which dressings of gas-lime would be likely generally to do good. Gas-lime is utterly poisonous to the life of insects and similar small organisms, and applied with requisite care, as to amount and condition, would, I believe, be excellent for the Clover; in my own very limited experiments I have found an excellent growth follow on the application.

Where a field of Clover is so ruined by "sickness" that it has to be done away with, the infestation would appear to be necessarily done away with afterwards, if it was feasible to pare, collect, and burn the parings, and dress the exposed surface immediately before turning or further disturbing it with fresh, still caustic, gas-lime. In this way

the infestation in the Clover would be perfectly destroyed, and that on the surface of the land where the Eelworms which had left the plants were (or probably still were) lying would be got rid of, and subsequent ploughing and operations in due order, giving, of course, the requisite number of weeks for the gas-lime to oxidise and become harmless, would be treatment apparently suitable to all points of the case.

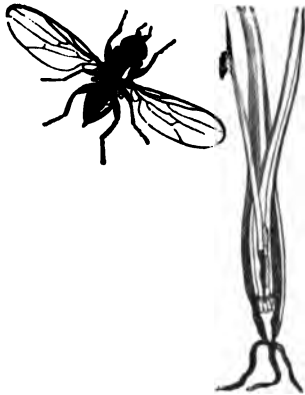
To put in Clover after Tulip-rooted Oats, or Oats after "Clover-sickness," or any crop liable to infestation after one suffering from Eelworm, is manifestly undesirable, and, where nothing else can be done, a deep ploughing with implements fitted to take off the first land-slice separately and bury it well down, is a thoroughly good measure.

It is also to be remembered, as a most important point, that this kind of Eelworm can be passed through the cattle feeding on plants infested by it without injury; therefore, manure from cattle fed on infested Clover is greatly to be mistrusted for application to Clover crops or Oats.

For further notes on the subject of Eelworms, likewise for figure of nearly-allied kind of *Tylenchus*, see paper on "Tulip-root," and references in Index.

CORN.

Frit Fly. *Oscinis frit*, L. (? *Oscinis vastator*, Curtis).



OSCINIS VASTATOR.

Perfect fly, nat. size and magnified; and attacked plant, with maggot inside.*

* The *Oscinis vastator* of Curtis bears such a strong resemblance to the *Oscinis frit*, which is the subject of the present paper,—even if it is not absolutely the same,—that I have used Curtis's figure to give the appearance of the insect and its method of injury.

On June 21st a communication was forwarded to me, by direction of Mr. Chamberlin, regarding some stems of Oats injured by insect-attack, which were sent from the Hill Farm, Stratton Strawless Hall, near Norwich. It was mentioned "that the specimens were taken from a field of sixteen acres, part grown with Tares and part with Oats; the soil is loamy sand, with gravel subsoil. A fortnight back we noticed a few roods of them dying off, and now about three acres are affected; and I find, on examining them, that there is an insect to be found inside the stem against the first *joint* from the root."

On examining the plants I found a small legless maggot, which was clearly that of a two-winged fly, and which was furnished with two large breathing-pores or spiracles near the head, and had also two tubercles or wart-like spiracles at the end of the tail. I fastened up the plants securely, and in less than a month plentiful numbers of a little black, brightly-shining, two-winged fly made their appearance. These were only about an eighth of an inch in length, and were very observable from their habit of skipping in all directions.

Samples of these flies I forwarded, in order to obtain their name with perfect certainty, to Mr. R. H. Meade, of Manningham, Bradford, Yorks., who was good enough to examine them, and replied that they were well-marked examples of the *Oscinis frit*, L.

During the last season I only received two notes of observation of this kind of attack, but, as I have reason to believe, from observation in previous years, that the attack is not uncommon to various kinds of corn plants in the spring, and sometimes does a good deal of mischief, it may be as well to draw attention to it.

The method of life* is said to be for the female to lay her eggs singly on the under side of a leaf. The maggot from these eggs creeps into the heart of the young plant down to the collar, and gnaws the youngest leaves at their base down to the centre of growth, and so destroys the terminal bud of the shoot; and, when this happens, further development is checked, and, where the plant is running up to stalk, the damage is especially perceptible from the yellow or reddish colour of the leaves and the weak growth.

When the maggots are full-fed, about the beginning of June, they penetrate through the sheathing-leaves, and change to chrysalids beneath the outermost or next to the outermost of these.

The attacks which I have seen in various years correspond with the above description of attack in the winter and spring plant, and in the year 1881 I had specimens sent early in June from near Tewkesbury of young wheat plants much injured by attack of a small whitish grub furnished, as above mentioned, with two tubercles at the end of

* See 'Praktische Insekten kunde,' by Dr. E. L. Taschenberg, pt. iv., pp. 151—153.

the tail, and otherwise resembling the description given above, which developed to an *Oscinis*, either *frit* or indistinguishable from it. The damage in this instance was very severe, estimated by the owner at fifteen bushels per acre on nearly fifty acres of fallow wheat.

The exact nature (that is, the precise cause) of the above kind of injury to the young corn has been difficult to make out, as in the instances reported, though the mischief was much the same in all cases, it was plain there were two kinds of maggots present, turning to two quite distinct kinds of flies. One of these I have described above; the other, as I mentioned at length in my Tenth Report, was of a very differently-shaped maggot, small at the head-end and truncate at the tail, and turned to a small greyish two-winged fly (the *Hylemia coarctata*). Both of the above attacks appear so similarly destructive that at the present I do not see much to distinguish them by, as far as the plant is concerned, excepting that it appears that the maggot of the *O. frit* goes into chrysalis in the attacked plant, and the maggot of the *H. coarctata* is considered, either usually or in some instances, to leave the plant and go into chrysalis in the ground.

With regard to prevention, we do not seem at present to have a clue as to how to prevent attack on *spring-sown* Wheat, or on the Oats and Barley, for we do not know where the flies which lay the eggs pass the winter; but it has been noticed that the attack particularly takes place to Wheat sown after bare fallow. If this Wheat was sown early in the autumn, whilst the flies from the summer brood were about, this would quite account for the attack taking place; and therefore it seems probable that, as with Hessian Fly attack, at least to autumn-sown Wheat, might be quite avoided by *late autumn sowing*.

In the course of the coming year I should be very glad to receive, for examination, heads of Wheat, Barley, or Oats, in which the grain may be observed to be deficient and small, accompanied by presence of small whitish maggot, which possibly might help us to knowing the summer form of attack of the "Frit" Fly.

The Hessian Fly. *Cecidomyia destructor*, Say.*



CECIDOMYIA DESTRUCTOR.
Hessian Fly, nat. size and magnified.

THE year 1886 was memorable, agriculturally, for the appearance of the Hessian Fly as a pest of the Wheat and Barley in Great Britain; and 1887 has shown it to be to all appearance settled in the country. Whether the fly had been present before last year we cannot tell, but we can tell very certainly that it was not *known* to have been present; and also that its attacks had not been recorded agriculturally; nor had the fly, the *Cecidomyia destructor*, Say, been entered in the lists of British insects.

There are several kinds of injury to growing straw,—some caused by weather, some by insects,—which, in their effect on the stalk, bear such a strong general resemblance to that of the Hessian Fly maggot that without careful examination it is almost impossible to tell the difference. Many such have been sent me during the past season, with the inquiry whether it was “the dreaded pest,” and, as in the many surmises sent me as to this attack having been noticed ten or twenty or even fifty years ago not one instance has ever been given of the “flax-seed” being found near the knots of the stalk, my own opinion certainly is that the attacks were of the same nature as those so generally mistaken for the Hessian Fly attack at the present day.

But however this may be, the case, as it stands now, appears thus: Hessian Fly made its first appearance as an acknowledged pest amongst us last year over a small area in England, and a larger and more scattered area in Scotland: this year the area of its presence has increased to a more or less broad band sweeping up the eastern side of the kingdom from Kent to Cromarty, and also present at some localities in the South of England but at the same time, although the weather has been what is considered exceptionally suitable to the

* This paper is a reprint, with additions, of my pamphlet, ‘The Hessian Fly in Great Britain in 1887,’ which was issued during the winter in order to give the reports of the past season as soon as possible.—Ed.

insect, the damage has only here and there been to the amount that was to be feared from what has taken place in other countries.

No damage has hitherto been reported on the *young* Wheat or Barley; the accounts of attack are limited to injury to plant when running up in stalk, and in this condition, although much injury has in some cases occurred to Barley, Wheat appears to have done what is called "resist" attack, and strong firm stems of good sorts well cultivated not to have elbowed down, or to have suffered but little under the attack of the pest.

In the following pages I have endeavoured to class the information sent in during the past season under the following heads:—

First appearance of the perfect fly (male and female) from "flax-seeds" preserved from last autumn's British crops.

First appearance of attack on the crops.

Observations of appearance of the pest on Wheat and Barley, which I have arranged in order of date, and under the heads of the countries in which they occurred, *viz.*, England and Scotland.

Observations on other points which have been investigated, as examination of imported straw and sweepings of ships; non-presence of Hessian Fly attack on Oats; information regarding the species of parasites which have been identified as found in Britain; kinds of Wheat which have been reported as not suffering much under attack, &c.

These observations are arranged for convenience of reference under their respective headings, and two maps are added, showing the districts known to be infested both in England and Scotland.

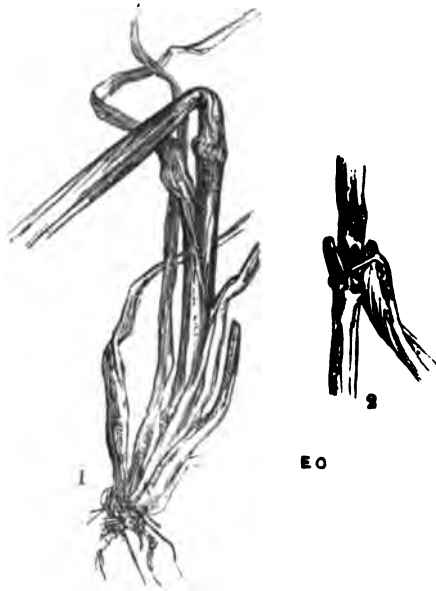
LIFE-HISTORY OF HESSIAN FLY.

For such as may not have studied the nature of Hessian Fly attack, it may be desirable to mention that where the attack occurs (as it mostly does with us) to the growing stalk, the white legless maggot feeds *outside* the stalk, but *inside* the leaf-sheath just a little above one of the knots. Commonly it is just above the second knot, but the attack may occur lower down at the first knot, or close to the root, or higher up above the third or fourth knot.

The mark of attack being present is the stem elbowing sharply down just above where the maggot lies. It does not commonly break, but, unless the straw is very firm, it bends at the weakened spot, and thus damage is caused to the fallen head, besides difficulty in reaping from the confused state of the straw.

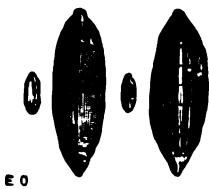
It appears from Dr. Lindeman's careful observations in Russia that the larva (or maggot) lives about twenty-eight days in this condition. Then it changes at the precise spot at which it fed to a

brown flat chrysalis, in size and shape and colour strongly resembling a rather small and narrow flax-seed, whence the name of "flax-seeds"



Attacked Barley-stems. 1, elbowed down ; 2, showing "flax-seeds."

is commonly given to these chrysalis-cases or puparia. Within this hard outer husk the maggot changes to chrysalis, and the chrysalis to the perfect fly, but how long this may take depends very much on circumstances. It may occur, under natural and favourable circumstances, so soon that the whole time occupied in the life of the fly from egg to development is only forty-eight days ; but it has been shown that if the *puparium*—to give it the precise name—is put in unfavourable circumstances, development may be greatly retarded. Thus some of the flies may come out in autumn in the fields, and others threshed out, or stacked in the straw, or kept artificially for investigation, may very likely not hatch until



"Flax-seeds" or puparia in different stages of development, nat. size and mag.

May, or much later in the following year. The perfect fly much resembles a stout-made little brown gnat, about one-eighth of an inch in length, with one pair of smoky-grey wings, and with long horns.

For those who desire a full and trustworthy scientific description of the fly (that is, the imago of *Cecidomyia destructor*, Say) I append the technical account of both male and female by Mr. R. H. Meade,

of Mount Royd, Bradford, from *living specimens* (published in the 'Entomologist' for July, 1887). The specimens were bred by Mr. Inchbald from "flax-seeds" (or puparia) forwarded by Mr. D. Taylor, jun., from his farm of Daleally, Errol, N.B.

CECIDOMYIA DESTRUCTOR, Say.

Thorax niger. Abdomen carnosum, femina maculis nigris quadratis disjunctis, mare confluentibus, signatum. Antennæ 17-articulatæ, mare petiolatæ, femina sessiles. Epistoma cirro nigro instructo. Pedes testacei nigro-hirti. Alæ nigrescentes, radicibus rufis. Long. mas. 2, fem. 3 mm.

FEMALE.—The female being the larger, more abundant, and more characteristic sex, I shall first describe it, and then mention the distinctive points of the male.

Head. Eyes, with forehead and occiput, black, the last clothed with thick and strong black hairs. Epistome prominent, and furnished with a tuft of black hairs. Palpi yellow, the four joints being partly covered with black scales, which are more numerous on the second than on the first and third divisions, and entirely cover the terminal joint. Proboscis very small, and of a pink colour. Antennæ rather more than a third of the length of the body, yellowish brown, consisting of seventeen joints shortly verticillated with black hairs. The two basal joints are nearly twice as thick as the others; the first is club- or rather cup-shaped; the second nearly globular; the next are all smooth and cylindrical (turning irregular in size and shape when dry), about twice as long as broad, becoming gradually rather smaller towards the end, and terminating in an elongated tapering joint, which is about half as long again as the one before it. Collar or neck pinkish yellow.

Thorax black, with grey reflections, having a few scattered white hairs on the sides, and two indistinct lines of thinly placed white hairs along the dorso-central region. A pinkish red irregular-shaped streak or patch runs from the side of the neck along the lower side of the thorax to the base of the wing. *Scutellum* black, prominent, and crested with black hairs. *Halteres* pale red, irregularly clothed with patches of black scales.

Abdomen pinkish or yellowish brown, with eight segments; the first is nearly black: all the others are marked on each side of the dorsum with a large square velvet-black spot, which spots are separated by a considerable longitudinal space from those on the opposite side on all the intermediate segments, but become nearly confluent on the seventh and eighth joints. A single row of similar large square spots runs down the centre of the ventral surface. The oviduct consists of three joints; the basal one is thick and rounded, the second and third are cylindrical, the last one being of about half the diameter of the second, pointed, and without lamellæ. They are all pale red, the terminal one being brown at the tip.

Legs pink, becoming brownish yellow after death, clothed irregularly with black scale-like hairs, which are generally thicker in the neighbourhood of the joints. The coxæ are brown, the short fore femora or trochanters black, the others yellowish brown. The ends of the tarsi and fore tibiæ are generally darker than the other parts.

Wings pink at the roots, and clothed with black hairs; the second longitudinal vein runs nearly straight until near its extremity, when it curves slightly down and reaches the border of the wing a little above (or before) the apex. The third longitudinal vein gives off its descending branch in the usual way, which reaches the hind margin of the wing at a point exactly opposite the termination of the first longitudinal vein.

MALE.—The male insect differs from the female by being about one-third shorter

and much more slender. The antennæ have the same number of joints (seventeen), are pedunculated, and proportionally longer, being about two-thirds of the length of the body. The joints are ovoid in shape, becoming nearly globular towards the end. The terminal joint is not longer than the others, as in the female. The stalks are about half as long as the joints. The verticellar bristles are much longer than those in the female, and white in colour. The tuft of hairs on the end of the scutellum is also white.

The *abdomen* is almost black, with a pink extremity, but is really marked in the same way as the female, with large square black spots, only being very slender they coalesce; thus the two lateral rows cover the dorsum, only leaving a narrow pink line down the centre, which is sometimes indistinct, and a pale streak across the edge of each segment. The spots on the ventral aspect hide the underlying colour altogether. The last joint of the abdomen is of a pale pink colour, and is provided with a pair of claspers or forceps of a brown colour, between which are seated the generative organs, the peculiar structure of which is now found to be of great importance in the determination of nearly allied species among various insects, but which it is very difficult to describe without the aid of figures. Two thick blunt processes, which project forwards, are placed between the roots of the forceps, each of which has a small rounded eminence on its extremity. Beneath and behind these, occupying a central position, is an elongated tapering organ extending nearly to the joints of the claws of the claspers, which is flanked on each side by a flattened hairy process with a dilated extremity. These organs are of a pink colour.

The *legs* are rather paler than those of the female; the fore coxæ are pink.

The *wings* are proportionably longer than in the female, and less nigrescent. Mr. Inchbald tells me that when they are first expanded, "a ruddy tinge is observable throughout the wing." This is less conspicuous in the female.

R. H. MEADE.

1, Mount Royd, Bradford, June 15, 1887.

The above is given by kind permission of Mr. R. H. Meade, and also of Mr. Newman, proprietor of the 'Entomologist.'

**FIRST APPEARANCE IN 1887 OF THE HESSIAN FLY FROM "FLAX-SEEDS,"
OR PUPARIA, TAKEN FROM THE PREVIOUS YEAR'S CROPS AND PRESERVED IN ARTIFICIAL CIRCUMSTANCES FOR SPECIAL OBSERVATION.**

The following notes of observation of the puparia, or "flax-seeds," of the Hessian Fly, up to the hatching out of the perfect insect, with which I was favoured by Mr. Peter Inchbald, of Fulwith Grange, Harrogate, are of much value, as coming from one so well known as a special observer of the Cecidomyiæ. It will be seen that these notes give the change in the appearance of the "flax-seeds" which occurs just before the fly hatches out from them; the time of day at which the hatching out takes place; the proportion of males to females; the duration of the life of the flies; and likewise the many weeks over which the successive appearances of these flies (that is, scientifically, the imago of Cecidomyia destructor, Say) extended. To these are added notes of appearance of the Hessian Fly in captivity, respectively a few days earlier and a few days later than recorded by Mr. Inchbald, namely, in the first case on or about May 18th,—certainly before

May 20th; and, in the second case, on July 20th, which is the latest observation given of appearance from the preceding year's puparia.—ED.

On May 3rd Mr. Inehbald wrote:—"I had hoped long ere this to have sent you types of *Cecidomyia destructor*; the cases are very brown. I feel some moisture is essential to their development. All the Cecid group are lovers of moisture."

May 9th: "As I told you, the pupæ of *C. destructor* are gathering intensity of colour daily."

No further progress of alteration of appearance was mentioned until May 27th, when Mr. Inehbald wrote:—"My pupa of *C. destructor* has turned very red,—*glowing*: its eyes are to be seen and its antennæ; legs are all folded in their sheathing covers waiting extrusion"; and two to three days after this change the Cecids (that is, the Hessian Flies) began to appear out of the "flax-seeds" or puparia.

On May 30th Mr. Inehbald wrote:—"I have reared three *C. destructor*, one male and two females. The male emerged on May 29th, and the two females on the 30th (this morning). They begin their winged life very early, I expect about sunrise; at all events, the perfected existence is attained before six o'clock. An early riser must he be who intends to look on the whole transformation-scene from the crack first made above the thorax to the drawing out from the sheath of the body of the gall-gnat. I have the little silver shroud, too, in itself an object of beauty, protruding from the puparium like molten silver, and the tracings of the little form that it has served to shelter so long are all there. I have examined both the male and female very closely; little, if anything, can be added to your wonderfully accurate engravings. The ovipositor is of great length, telescopically formed; the colour is deepest at the abdomen, fades gradually away as it reaches the tip."

On June 1st Mr. Inehbald forwarded me a specimen of the male *C. destructor* which he had reared, in excellent condition, together with the pupa-case and the "shroud" or light film which had enveloped it (the imago or perfect fly) now protruding from the pupa-case, and thus proving the development of the Hessian Fly to take place from these "flax-seeds" or puparia, and from nothing else.

Mr. Inehbald had now (June 1st) bred two males and two females from British "flax-seeds." By June 23rd he had reared twenty-one specimens (six only of them male); by July 1st he had reared twenty-five in all (seven males and eighteen females). Of these he noticed that they appeared early in the morning, and did not live for more than three or four days at the most.

Specimens of these Hessian Flies (or, to give them the full technical description, specimens of the imago of the *Cecidomyia destructor*, Say,

reared under Mr. Inchbald's own care from British puparia) were kindly distributed by him, so as to be in the hands of those especially interested in the matter, amongst whom were Prof. Westwood, Life-President of the Royal Entomological Society; Mr. R. H. Meade, our well-known eminent Dipterist, whose excellent description of both male and female has been given at pp. 15-16; Mr. Whitehead, of Barming House, near Maidstone (Agricultural Adviser to the Department of Agriculture); myself, and some others. There is therefore now no want of well-authenticated specimens of this new corn-pest, so placed as to be available for service.

On July 19th Mr. Inchbald wrote:—"The last I bred was a female on July 18th. Altogether I have reared twenty-seven specimens of *C. destructor*."

May 20th, Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., to whom we are all indebted for his long and carefully conducted observations on Hessian Fly, and matters connected with it, reported to me, on May 20th, that he had bred the perfect insect from his "flax-seeds."

On July 20th Mr. C. Whitehead wrote me, from Barming House, near Maidstone:—"I have found to-day a Hessian Fly, hatched from last year's puparia, in the bottle in which they have been since Christmas. . . . This proves that they will remain a long while in pupal form, and are more dangerous thereby. . . . I put moisture in the bottle about a fortnight or three weeks ago."

The above notes are of serviceable interest, as showing for one thing the effect of moisture in bringing about development of the fly, and, for another, how long development and the appearance of the fly from the puparium or "flax-seed" may be postponed, as these "flax-seeds" were collected from crops gathered in the preceding autumn. The protraction of time of development in non-natural circumstances is of some importance practically, and attention has been drawn to the point by Dr. Lindeman in his work on the Hessian Fly in Russia.—ED.

FIRST APPEARANCE OF HESSIAN FLY ATTACK ON BARLEY IN 1887 IN ENGLAND AND SCOTLAND.

The three following observations refer to the first records given of appearance of Hessian Fly in its maggot and chrysalis stage on the growing crops in 1887. The first observation was reported on July 7th, the second on July 11th, and the third on July 12th; the first of these observations being Scottish, the two others English.

On July 7th Mr. Pattullo wrote as follows from Eassie Farm, Meigle, N.B.:—"I have sent to-day a box with stems of Barley

affected with the insect I wrote about ; and I notice two of the specimens I send you are brown, and that the larvæ seem darker in colour than when I looked last.

"I am at a loss to understand how the fields have become affected, should this turn out to be an attack of the Hessian Fly, as the Barley was not dunged, and the dung applied to the Turnips the previous year was turned and heated, the mixture being half town's dung and half farmyard manure.

"I have two fields of Barley affected, and I also saw a few stems in a field of Wheat. I may say I have only had three tons of foreign straw in the last few years."

The above letter was forwarded to me on July 8th by Mr. Taylor, of Daleally Farm, Errol, with the following remarks:—

"I have just had some samples of Barley-straw sent to me, on which I find the larvæ of the Hessian Fly ; and I send by same post as this a few of the samples for your inspection.

"I have just written him saying that I have no hesitation in stating that his Barley is infested with the maggot of the dreaded Hessian Fly. I have as yet not observed any damage on our own crops, neither do I find any 'flax-seeds' on imported straw. I have reared one more fly, but plenty of parasites."

On July 16th Mr. Pattullo forwarded specimens to myself, also from Eassie Farm, Meikle, Forfarshire. These I found to be of the Hessian Fly maggot (i.e., larva of *Cecidomyia destructor*) in various states of growth or development, from the white shiny condition, or state just changing to the chrysalis, up to the complete change to chrysalis-case (*puparium*), or so-called "flax-seed" state, these "flax-seeds" being in some instances longitudinally striated. The attacked Barley was in very poor condition. Mr. Pattullo wrote accompanying:—"I send by to-day's post specimens of the maggot infesting my Barley. . . . I think the attack is over, as I had some difficulty in getting the maggots in their earlier stages, as you wish them. I see a good many of the brown specimens shrivelled up, as if the recent rains had destroyed them."

A few days after this (that is, on July 11th) very characteristic specimens of Hessian Fly attack, having the puparia or "flax-seeds" with the longitudinal striæ already beginning to show, were sent me from the Church Farm, Steeple Morden, Royston, on the border of Cambs. and Herts, by Mr. T. J. Hunt, with the remarks:—"I enclose specimens of Barley taken from a piece of mine. . . . The piece of Barley in question is after Tares, and is not a good piece ; and I find that there are more broken-down ones where the crop is weaker, though there it is not broken down very much."

On the following day (July 12th) I received the following communi-

cation from Mr. G. E. Palmer, jun., of Revell's Hall, Hertford, who, it will be remembered, was the first observer of the attack of Hessian Fly in this country. Mr. Palmer wrote me:—"I am now finding a considerable number of pupæ of the Hessian Fly in our Barley, and fear that the attack will prove quite as bad, if not worse, than last year, and this notwithstanding the precautions we have taken to destroy the pupæ during the autumn and winter. The field in which I have found most is quite half a mile from where we had the attack so badly last year, and was Mangolds last year. I am afraid this dry weather is all in favour of the 'fly,' and I find that the hot dry ground is suffering most from the attack, as it did last year."

FROM THE MIDDLE OF JULY UNTIL THE END OF AUGUST reports were constantly transmitted of the appearance of the pest.

It is difficult to arrange these on any special plan, as they often contain information on very various points; and yet to separate these points one from another would destroy the value of the report. I have therefore, after the preceding notes of first appearance in England and Scotland, divided the others into English and Scottish observations, and arranged them according to date of appearance, with occasional notes to draw attention to points of especial importance.

For the most part they will be found to refer simply to note of attack, with date and locality; but some observations will also be found of amount of injury, names of variety of Wheat grown, effects of agricultural treatment, and also of the presence of the "flax-seeds" on the stem being sometimes above the first, third, or fourth knot, as well as above the second.

NOTES OF OBSERVATION OF ATTACK IN ENGLAND DURING JULY, 1887.

On July 15th Mr. F. M. Campbell, President of the Herts Natural History Society, wrote me from Rose Hill, Hoddesdon, regarding the pest under consideration:—"I am sorry to say that it is not only plentiful in Mr. Palmer's fields, but here also. Here I have found it in Wheat close to the root." And on the 19th Mr. Campbell forwarded samples of the attacked Wheat, with the note:—"Most of them are on the first joint, and one stalk has been visited both on first and second joint. It is evident most of the puparia about us in Wheat will be left on the field after reaping. . . . *C. destructor* may be said to infest our whole parish." And on the 26th Mr. Campbell added, "Hessian Fly to my knowledge is over the whole Hoddesdon, Ware, and Hertford districts."

July 16th. The Rev. W. Hopkinson, writing from Sutton, Wansford, forwarded specimens of attack on Barley, with subsequent

information, on Aug. 1st, that these were from Gidding, Hunts, and that he found it there in all his corn crops. And that "here also in Northamptonshire I find it in every crop I have examined."

July 18th. Mr. T. P. Brand forwarded a sample of attack from Brook Hall, Foxearth, Long Melford, with the note that, if these were pupæ of Hessian Fly, "we have got plenty of them on my farm at Foxearth, and also on my Shimpling Hall farm, seven miles distant, in the county of Suffolk." The "flax-seed" in this case were found on Wheat, and on Barley also, and the crop was very much damaged. It had a root-fallen appearance, and the ears on the affected stems were dead and the kernels shrivelled up.

July 18th. A note was sent me from Beauchamps, Buntingford, Herts, by Mr. Robert Pigg, of a small white maggot with a green spot on it near one end, which he found in a piece of Barley. This maggot, being situated "under the flag eating into the stalk,"—on a sample of the attack being forwarded to Mr. Palmer,—he returned reply to the sender, "I am afraid there is no doubt but that the insect you sent me is the larva of the Hessian Fly." [The green mark often to be found along the upper side of the Hessian Fly maggot is caused by the green juice of the food it has eaten showing along the food-canal.—Ed.]

On July 19th Mr. F. I. Hunt, who had, as above mentioned, sent me specimens of attack to Barley on the 11th of the month, forwarded (also from Steeple Morden, Royston) specimens of Hessian Fly attack on Wheat. He also mentioned, "I find the Hessian Fly slightly in very many pieces of Barley,"

July 20th. Mr. Palmer forwarded me, from Revell's Hall, Hertford, the following notes of the advance of the attack:—

"Since my return I have made a further examination of our corn, and I can see that the damage caused by the Hessian Fly has considerably increased, and is quite as bad, if not worse, than last season; this is in the Barley.

"I also find a small amount of damage to the Wheat from the same cause, but not nearly to so large an extent as to the Barley. I have had a specimen of the larva sent me from a farmer at Buntingford, Herts, who reports that he had noticed a field of Barley was not looking well, and, on examining it, found some of the larvæ in the straw, which he feared was the Hessian Fly.

"Mr. Dorrington [of High Mead, near Hertford, a good and competent observer—Ed.] also tells me that he has found pupæ in the fields near Hitchin, where he discovered it last year. I fear therefore that the attack is pretty general this year. . . .

"I was paying a short visit to Hampshire last week (near Petersfield), and took the opportunity of examining a field of Barley which

I passed through, and was not long before I found pupæ of Hessian Fly, but only a small amount."

July 28rd. Prof. Fream, writing from the College of Agriculture, Downton, near Salisbury, mentioned that, noticing the Barley in this neighbourhood was much bent at the second joint, he enlisted the aid of his students, and for the previous week they had been bringing in specimens of the Hessian Fly (of which samples were sent me) in the "flax-seed" state.

July 28rd. Mr. Arthur Smith, of Smallford, St. Albans, forwarded me specimens of Hessian Fly attack found by him in two Wheat-fields at Hill End Farm, together with some details of serviceable interest. Of three fields of Wheat contiguous to each other, amounting to fifty acres, one field (Clover in 1886, and sown at the end of October with Webb's "Challenge Wheat") had no attack. Of the other two fields, the part of No. 1 fallow in 1886, sown with Mustard, ploughed in, and sown with Webb's "Challenge" on Sept. 17th, had no attack of the Hessian Fly; but the remaining third (Swedes carted off and sown with April Wheat on April 12th, was mildly attacked. The remaining of the three contiguous fields (part fallow and Mangold, remainder Peas in 1886, sown with Webb's "Challenge" beginning of October), was more severely attacked. *Both pieces of fallow attacked were partly manured with London stable manure, portion of fallow not attacked with artificial.*

From the above note it appears that both the spring and the autumn-sown Wheat on the fallow were attacked where London manure was used.

July 24th. Mr. F. H. Cooke wrote from Deeping St. James, Market Deeping, Lincs., regarding a field of Barley attacked by the pest, of which specimens were forwarded:—"About one per cent. of the plants are bent sharply over above the second joint; some are broken right off. . . . I fear the attack is not confined to one or two fields, as, on looking in other crops in the neighbourhood, I find some of them attacked in the same way."

July 25th. Mr. Thomas Bunker, writing from Goole, forwarded specimens of the pest from a Wheat-field; and on August 1st further reported that he had found the chrysalids about a mile from the field first noted.

July 26th. Mr. H. Smith, writing from Sudbrook House, Ancaster, Grantham (with specimens of the attack sent accompanying), noted that he had found "a very large quantity" of the "flax-seeds" in his Barley. These were found just above the second joint of the Barley, which they had made knuckle-down. The heads of the corn, however, had not begun to shrivel up. The Barley was sown with seed obtained from Suffolk.

A few days later Mr. H. Smith further mentioned:—"The whole

of Ancaster is seriously affected. I had only time to examine one field at Grantham, eight miles off, and found it there. All the crops that I have examined are so badly attacked that one minute suffices to find it."

After examination the same day at Horbling (also in Lincolnshire), Mr. Smith noted that he found "flax-seeds" in two fields in about half a minute's examination.

July 27th. Specimens of attack to Wheat and Barley were forwarded to me by Mr. William Priestley, Offord Darcy, Cambs., with the note that he had found them that morning in the border of Cambridgeshire, a few miles from St. Ives.

On August 1st Mr. Priestley further reported:—"Since writing to you last week respecting the Hessian Fly, I have carefully gone over several Wheat and Barley fields on my farm, and find puparia in a state more or less advanced; in some cases the fly has gone. To-day I have been into five other parishes in this neighbourhood. Every field I went into similarly affected."

July 27th. Mr. John E. Thurnall, Royston, forwarded specimens of Hessian Fly attack on fields at Great Chishill, in Essex, about six miles from Royston. The fields infested, heavy land properly drained, and no foreign straw been used on the farm, which is $5\frac{1}{2}$ miles from a station; the land about 400 to 470 feet above sea-level, being nearly the highest part in the district. "The chrysalis seems always to be just above the second joint of the Wheat, and I am sorry to say there are many fallen stems, but just above the second joint."

July 28th. Mr. E. H. Riddiford, Sutton, near Sandy, Beds., sent me specimens of Wheat-stalks infested with Hessian Fly. He had found it in two fields of Square-head and Browick Wheat: and on August 1st he further mentioned that since writing he had found "flax-seeds" in corn of two of his neighbours (Wheat and Barley), and heard of it being found at more than one locality in the immediate neighbourhood.

July 28th. Mr. J. W. Poynter forwarded sample of Hessian Fly attack to his Wheat from Great Wackering, Southend, Essex,

NOTES OF OBSERVATION OF ATTACK IN ENGLAND DURING AUGUST, 1887.

On August 2nd Mr. Thurnall further reported from Royston, in continuation of his note of July 27th:—

"I have taken notice of various fields of Wheat and Barley in this district, and I find the 'flax-seed' Hessian Fly chrysalis in nearly every field. It appears in the following parishes in Cambs.:—Maldreth, Foulmire, Duxford, Ickleton, Trumpington. Essex: Chrishall, Heydon, Great Chishill. Herts: Barley, Reed, Therfield,

Royston." [some Barley-straw was enclosed with chrysalids at the third joint.—Ed.]

Mr. E. Blundell, writing from Birchmoor, Woburn, on Aug. 3rd, informed me that he had then only seen three specimens of "flax-seed," but would search more carefully and report if he found them or the larva in any number.

August 5th. Mr. Herbert Fenning, of Bedford Estate Office, Bedford, forwarded me specimens of Wheat infested by Hessian Fly from one of His Grace the Duke of Bedford's farms at Cople, near Bedford. In this case the puparia or "flax-seeds" were mostly at the third knot, although some were at the second and fourth.

August 6th. I received specimens of puparia taken by Mr. F. E. Fraser, from some of the Wheat-plots at the Experimental Farm, Woburn. One of these "flax-seeds" was placed near the root, and the striæ running lengthwise along the chrysalis-case were very observable.

August 8th. The following communication was sent from Weldon Grange, Corby, Kettering, by Mr. J. Rooke, together with specimens of Hessian Fly "flax-seeds," some of which were placed at the fourth knot of the infested straw:—"I enclose herewith several plants of Barley taken to-day from one of my crops, sown February 15th, and growing on gravelly land. I fear they contain pupa-cases of Hessian Fly; they are the first I have seen, and I have not heard of them in this neighbourhood. You will observe that the grain does not appear to be materially injured."

August 8th. Mr. G. Cook,^h of Flitwick Wood Farm, Ampthill, Beds., forwarded specimens of "flax-seeds" on Barley, together with specimens of attack of *Chlorops*, noticed under this head elsewhere.

August 8th. Mr. G. A. Saunderson, of Hook's Mill, Guilden Morden, near Royston (Cambs. and Herts), forwarded specimens, with the note that two of them "have the pupæ close to the root—so close, I think, if the stubble was burnt, unless first pulled up, the pupæ would not necessarily be destroyed. Three specimens of Wheat and one of Barley have the stem considerably shortened between the two knots, where the pupæ are to be found. . . . One straw contains a pupa two inches from the knot . . . I note the fly is more prevalent in Wheat than appeared some time since; but, except in a few cases, not so much so as in Barley; in two pieces in this parish close to here in the occupation of J. G. Johnson, Esq., it took me, I think, an hour to find one. I note also in Wheat, as the ear gets heavier, the characteristic bend, as in Barley, is more prevalent. When I began to look three weeks since there appeared to be nothing definite to guide to the affected straws."

August 10th. Mr. L. B. Woodforde forwarded me, from the Park

Farm Office, Woburn, Beds., specimens of Hessian Fly chrysalids, which he had that day found in a Barley field near. He mentioned that "considerable damage had been done to the crop, especially where it was late sown. Most of the pupæ appear to be in the second joint from the ground"; and on August 12th Mr. Woodforde further mentioned that he had examined crops in several fields, and had no difficulty in finding chrysalids of the Hessian Fly, and, from what he could hear, the attack was very general.

August 10th. Mr. W. Smith forwarded specimens from Marsh House, Quadring Eandyke, of puparia found on Wheat growing on land in his occupation in the parish of Quadring.

On August 11th, Mr. E. Riley, late of Kipling Cote, Market Weighton (who had previously been assisting me in investigations regarding Hessian Fly), writing from the Weir, Hessle, Hull, gave me the first information of the appearance of Hessian Fly in that neighbourhood:—"I am sorry to tell you I have found Hessian Fly in two fields of Barley within a quarter of a mile of here, one of the fields in large quantities. It is about four miles from Hull and sixteen miles from Goole, but I cannot trace any manure as having come from Hull. I enclose a few specimens."

August 11th. The following note sent me by Mr. R. Stephenson, from Burwell, near Cambridge, remarks, as in a good many other instances, on the small amount of real injury caused by the attack:—"Since writing you I have found 'flax-seeds' in three other fields of Barley, all one or two miles from each other, and from the field of infested Wheat. In one case the field is three miles from the nearest field known to be infested and in another parish, (Swaffham Prior). In all these cases the 'flax-seeds' are so few that the injury to the Barley is scarcely appreciable. I had to look closely to find any elbowed-down stems. I am thus inclined to think the Hessian Fly is distributed more widely than is generally supposed, and that in places such as the above, where they are as yet few in number, they are not suspected, and so not searched for."

August 11th, or a few days earlier, I had report, with specimens of Hessian Fly attack, from Mr. D. D. Gibb, of Thorn Farm, Lymington, Hants, and the remark:—"I was struck with the fact, when first I observed the 'flax-seed,' that in most cases it was shrunken and empty. Whether from inhabitation of parasite or from the natural hatching of the fly, I could not form an opinion."

Bridgwater, August 11th. A single specimen of the "flax-seed" was forwarded from Shapwick, Bridgwater, by Mr. E. Mills, with the information that he had found it in a barton where a farmer was stacking his Wheat. He had examined a great many stalks afterwards, but could not find another. The crop did not show signs of injury

from presence of Hessian Fly attack. Mr. Mills forwarded me the portion of the stalk, with the puparium or "flax-seed" still adhering, for my inspection.

This is one of the instances in which it would be of much interest to know what occurs next year, following on this very slight appearance observed, as, in reply to further inquiry, Mr. Mills wrote me, on Nov. 2nd, that he had examined a great quantity of Wheat, and on a great many farms, but could not find any appearance of attack except in this one case.

August 12th. A sample of Hessian Fly attack on Barley-straw was sent by Mr. E. Whitfield from Goring Heath (Oxon), near Reading, with a note that he feared he had discovered the presence of the pest in two fields of Barley. "I had not noticed it during the growth of the corn, for, owing to the long drought and the Corn Sawfly, it had looked bad,—short in the straw and thin on the ground; but to-day, when placing it in the barn, I was struck by the peculiar appearance of some of the stems, and on examination soon found the 'flax-seeds.'"

August 12th. Specimens of Hessian Fly puparia (one "flax-seed" down near the root) were sent me from Glanmore Cottage, Stony Stratford, by Mr. J. Stebbing, with the note that they were found on Wheat in that neighbourhood. The Wheat-stems on which they were found were fallen, and the corn prematurely ripened. "In all cases the attack of the insect is made near the root of the plant."

August 12th. Mr. W. Formby forwarded specimens of Hessian Fly infested Wheat-straw from The Cottage, Morningthorpe, Long Stratton, Norfolk, with the information that there were many more in his field.

August 18th. Mr. John Norwood wrote from Balby Bourne, Lincolnshire, forwarding stalks of Barley containing what proved to be "flax-seeds" of Hessian Fly for examination, and the observation that if this was the case, "this district is very badly infected indeed. For the last week I have found it in every field of Wheat and Barley on the farms under my management, extending to about 900 acres, belonging to Lord Aveland. In the twenty-acre field of Barley, from which the specimens sent were obtained, they may be picked up at *every step*. Several of the fields are sown with clovers and grasses amongst the corn; therefore it will not be possible to follow the course recommended, *viz.*, to plough in the stubble, &c. I have found similarly affected stems in several fields on adjoining farms, and I fear, from the large quantities found, some of which are near the third knot, and will be carried away in the straw, that it will be impossible to contend against them."

Pieces of Wheat-straw, with Hessian Fly "flax-seeds" at the

second knot, were forwarded on August 18th from Brant Broughton, Newark, by Mr. Francis Shaw.

August 18th. Mr. Edmund Riley, writing from Hessle, Hull, noted having found presence of the pest on Wheat at Lockington, about twelve miles from Hull, and nearer the sea. The field was situated in the Carr. And on the 19th he further added :—" Since I wrote you about finding the Hessian Fly at Hessle, I have found it at Lockington Carr, about ten miles from here ; also Huggate, ten miles farther north (and quite on the wolds) ; again at Bridlington, near the sea ; so that it seems pretty well scattered through the East Riding.

On or about August 16th specimens of Barley-stray infested at the second joint were sent by Mr. J. C. Swann, from the Manor Grange, Long Stanton, Cambridge

August 18th. Mr. Alfred Blomfield forwarded, from Orange Hall, Gosfield, Halstead, Essex, some samples of Hessian Fly " flax-seeds " found on the stems of some Wheat which he was then cutting. One of these chrysalis-cases was empty.

August 18th. Infested straw sent from Swinhope, Great Grimsby, Lincolnshire, by Mr. F. Scorer.

On August 16th Mr. E. Whitfield, writing from Goring Heath, Oxon (near Reading), reported :—" I have found more of the " flax-seed," but only in the two fields mentioned ; they are about a mile apart, and not in any way connected " : and on the 19th forwarded some specimens collected from his Wheat-stubble at Goring Heath, showing the " flax-seeds " placed low down at the root.

The only note of attack which I received from Northumberland was sent me on August 19th, from Holburn Mill, Belford, by Mr. Henry H. Avery, with " flax-seeds " accompanying, mentioning that he had found the attack in a field of Barley on his farm. The stalk of corn attacked was broken down at the second joint from the ground, and when examined two of the " flax-seeds," of which samples were enclosed, were generally found.

On the 22nd of August Mr. Thomas Bunker, of Goole, reported, with specimen accompanying, that he had found the fly (mostly as a chrysalis, but occasionally as a grub) in five parishes, viz.. Goole, Hook, Airmin, Rawcliffe, and Balne."

On August 22nd specimens of attack were forwarded from his farm at Thuxton, near Hingham, Norfolk, by Mr. Frank Oddin Taylor.

August 24th. Mr. Maxwell Lefroy, of Crondall, Hants, gave me a note of Hessian Fly attack being found on Wheat on a tenant's farm, although his own was free.

August 21st. Mr. E. J. Thynne, writing from Haynes Park, Bedford, noted :—" I have found the Hessian Fly in abundance in the

Barley on two farms in this parish (Haynes), and to a small extent in the Wheat. I have also found it in the adjoining parishes of Wilstead and Houghton Conquest."

On the 24th Mr. Thynne wrote further, enclosing specimens of puparia, and mentioned:—"I have found but few in Wheat, and I think they seem to attack the weaker stalks; but the ears of the stalks on which I have found them are not always small, and sometimes do not show any signs of being the worse for being attacked."

Mr. Thynne further noted that the straw was so very dry that the "flax-seeds" flew out very readily. This is an important point relatively to dispersion of the "flax-seed" at harvest-time.

On August 27th Mr. Inchbald wrote me that—"In looking through Wheat and Barley fields between Harrogate and Wetherby hardly a field had escaped the ravages of the Hessian Fly; indeed we found it, I may say, in every field but one,—that field had been swept by the wind so that it was difficult to 'spot' the affected culms. I noticed that the root—or rather, I should say, the collar of the plant—was more destroyed where it grew in alluvial soil. I often found as many as four cases *in situ* on the collar of such plants, not generally at the first or second knot, as was ordinarily the case where the soil was more friable. In some fields the plants were so affected that it is difficult to believe that two generations could have multiplied in so short a time; they gave the impression that they may have suffered from depredations which have spread over several years." . . .

I also received specimens of puparia of Hessian Fly found in a Barley-field in Holderness, Yorks., from Mr. T. Barker, of Sproatley Rise, Hull; and later on (that is, at the beginning of November) I received information, with a sample accompanying, from the Rev. J. H. White, Weybridge Vicarage, Suffolk, of Hessian Fly having been found by Mr. C. C. Jacobson, of Weyland Hall, pretty well distributed over the parish, but that the attack was not considered to be serious.

OBSERVATIONS OF ATTACK IN SCOTLAND DURING JULY, 1887.

On the 15th July I received samples of a very decided case of Hessian Fly attack from the Editor of the 'North British Agriculturist.' In this instance the pest was present in advanced larval (maggot) stage,—white and and parchment-like, save where a strip of green caused by the food imbibed showing through the skin ran along the grub. Some of the maggots were beginning to turn brown, and some thoroughly characteristic puparia were fully developed, with well-marked longitudinal ridges and furrows. By the courtesy of the Editor I am permitted to use the accompanying communication sent to him:—

"I herewith send you some stalks of Barley with caterpillar in them, which I fear is Hessian Fly. The field where they grew is on high ground, and has not got dung of any kind for sixteen years, the crop having always been sown with light manures. Last year the Turnips on it were a fair crop, and two-thirds of them were eaten on the ground by sheep, along with linseed-cake and hay made from natural grass. If this is Hessian Fly, how has it got there; the field being surrounded on three sides by grass and on the fourth by hill-ground, and no fly having been in the neighbourhood last year."—(Signed, "STRATHMORE.")

On July 21st Mr. D. Taylor, of Daleally, Errol, N.B., who was the chief and earliest observer in Scotland in 1886, as Mr. Palmer was in England, reported the reappearance on his land of the attack; and the following letter from Mr. Taylor shows the much more obvious condition of attack at Daleally at above date, in 1887, than in the preceding year:—

"I went through some of our fields yesterday, and I find the Barley much broken down, a great deal more so than was the case last year; even if one did not know about the system of the attack, they could not fail to be attracted by the vast number of broken-down stalks. I went through our barley last year, and tried to find out the reason of so many black *ill-favoured* heads, but there was certainly not much broken down; the attack must have taken place later than it has done this year. You may have observed that the specimens of stems I sent were many of them pretty strong, and bore a good head, and the point of attack was almost invariably just above the second joint. This year the attack I find is mostly above the first joint, the part below in some cases much decomposed, the stalk-growth seriously stunted and prematurely withered, the head only partially shot, and in many cases the whole stool dead."

On July 25th I was favoured with the following note from Mr. Robert Carmichael, of Drumphin Farm, near Crieff, Perthshire, which is of special interest, as giving, besides notes of locality of attack in the Carse of Gowrie, particulars of the condition of attack at Drumphin, compared with observations taken on that ground in the previous year.

Mr. Carmichael forwarded specimens of the attack which he had found on the previous day "in one field of Wheat" and four fields of Barley on two farms on the Braes of the Carse of Gowrie, about four miles north from Errol, where so much of the "flax-seed" was found last autumn. I also to-day looked over our own and two adjacent farms, on each of which I found the Barley more or less broken down by the pest; on no field I examined did I fail to find it. There is this peculiarity in this year's attack that I did not notice last year,—the

white bleached stalk lying flat on the ground, when pulled up comes away out of the socket with the "flax-seed" sticking into the side of the end, having been under the very lowest leaf at the root, others having been considerably up the stalk, and one being evidently hatched this season, there being only a thin skin left.

July 25th. Mr. J. Blythe Myles wrote from Pitcany, Bervie, Kincardineshire, with specimens accompanying, as follows:—"I enclose a few Barley-stalks, which I fear have suffered from the attack of the Hessian Fly. The stalks have the peculiar bend, and there are above the knots of the stem and under the sheathing something similar to small "flax-seeds," but longer in proportion to the breadth than what they are. There are a very great number of stalks like that among my Barley."

July 26th. Mr. Andrew Spence wrote me from Mountboy, near Montrose, N.B., with samples of the pest which he had that day discovered in a field of Barley:—"The field was manured with stable-yard manure last year to the turnip crop, but there was no foreign straw used. I notice it in a field of Wheat, but not to such an extent as in the Barley." Mr. Spence further communicated to Mr. D. Taylor that a field of Wheat belonging to him was slightly injured, but his Barley was terribly damaged.

Mr. D. Taylor wrote:—"I have found it on a good many farms in the Carse, and on highly cultivated land too."

July 29th. Specimens of attack both on Wheat and Barley were forwarded from Upper Tulloes, near Forfar, by Mr. David Osler, with the note that the attack had appeared on his farm:—"In a 25 acre field of most luxuriant Barley we have found it throughout all the field, but worst in some thin spots." A specimen was enclosed "from a very fine field of Wheat."

July 29th. Mr. James Rodger, writing from the Estate Office, Mertoun, St. Boswell's (Roxburghshire), forwarded me a few stalks of Barley unmistakably attacked by the Hessian Fly, and mentioned that he found that "many fields on our estate here were unmistakably attacked. One field of Barley is especially bad; and on the headland of the field this morning I had no trouble in gathering an armful in a very short time. This is the first attacked field that I have heard of in the Borders."

OBSERVATIONS OF ATTACK IN SCOTLAND DURING AUGUST, 1887.

The following note, recording wide-spread attack but with little damage resulting, was forwarded, on August 18th, by Mr. H. Lindsay Carnegie from Kinblethmont, Arbroath, Forfar, N.B., with specimens accompanying:—

"As far as I have examined the fields in this district, and from what others have told me, I should say that nearly every Barley field in this district of Forfarshire was infested; the Wheat is not so bad, and the *oat crop seems free*. The heads of grain do not seem any worse; they are quite full. Whether this arises from the harvest here being quite a month earlier, I do not know; but of course if the heads had to lie on the ground for a month, as in ordinary years, the grain in them would be spoilt. When first I examined the fields there seemed to me more 'seeds' than I found to-day, in each specimen. Either the fly has been hatched or the 'seeds' may have been shaken out by a gale of wind we had a few days ago. On the whole I think very little damage has been done this season, owing to the very early harvest."

The following notes—by Mr. W. Gillespie, of Athelstaneford, Drem, and of Mr. J. Smith, of Bilsdean, Cockburnspath—refer to attack in the South-east of Scotland. "Cockburnspath is on the boundary between East Lothian and Berwickshire. Bilsdean is about a mile and half distant, on the sea-shore of East Lothian, and about sixteen miles S.E. of Drem and Athelstaneford, where the 'Hessian Fly' appeared on Mr. Gillespie's Barley."

With regard to damage from attack, Mr. W. Gillespie, writing from Athelstaneford, Drem, N.B., about August 12th, mentioned:—"My Barley is not much the worse, the grain itself is no worse, but where the heads are down the reaper may not pick it all up; the head on the damaged stalk to all appearance is as good as the others."

August 18th. Mr. W. Gillespie forwarded me some more specimens of infested Barley-straw from Athelstaneford, with the note:—"My Barley is all more or less damaged with it, but not to a great extent, the crop being fully matured before the attack of the 'fly.' . . . I examined a field of Wheat yesterday to see if there was any 'fly' in it, but could find nothing."

The following communications, at dates of from 18th to 28th of August, refer to observations of Hessian Fly attack in the S.E. of Scotland, and were forwarded by Mr. J. Smith, of Bilsdean, Cockburnspath, N.B.

In the first accompanying specimens of infested Barley, Mr. Smith noted:—"I have also noticed Hessian Fly attack in Wheat."

On the 24th Mr. J. Smith reported more particularly that since writing he had an opportunity of visiting some farms lying high on the Lammermoors, probably as high as any where Barley is grown, and found them worse infested than those lying near the sea-coast:—"I still believe this attack extends over a much wider area than has yet been taken notice of."

On the 28th of August Mr. Smith further reported that "The

attack extends at least the length of this estate (Dunglass), between eight and nine miles in Haddington and Berwickshire; otherwise the tract of fine land bounded on the south by the Lammermoors, ending in the sea at Fast Castle, and the sixth milestone on the road east of Dunbar. I hear of it on the farms westwards, but have no information south of the Lammermoor range, having seen no one likely to know lately from that district. The Barley being later thereabout, I may yet be able to get away before it is cut, as the affected straws are more easily picked up before it is stooked."

Reverting again to regular order of date, on August 18th Mr. J. C. Buckmaster (of Schools of Science and Art, S. Kensington) sent me specimens of straw from a field near Kirklands, Dunbar, N.B., rather badly infested, but of which the crop had not suffered.

August 16th, or about that day, Mr. Neil M. McFarlane, writing from Percy Street, Stanley, Perthshire, reported as follows (samples of attacked Barley were sent accompanying):—"A great many fields in this neighbourhood are infested; in fact nearly every Barley field has some of the pest in it, and the Wheat to a less extent. I have examined most of the fields myself, and some of them are very bad. One field in particular is so bad that one-third of the stalks are broken down. The specimens I send you were taken from two different fields. The Barley in both is strong and good, as you will see from several of the stalks. I find that the puparia are as common at the third joint as the second. Some of the specimens I send you show them at the fourth joint. On one field I gathered twenty infested stalks, and of these fifteen had bent at the third joint. On one stalk I found the puparia scattered all over the stalk. Some farmers here consider that they have got the pest along with foreign straw, while others consider that the hot dry season this year has rendered the crops more liable to it than formerly."

August 17th. Specimens of Wheat-straw infested by Hessian Fly chrysalids were sent me by Sir J. Stewart Richardson, from Pitfour Castle, Perth.

On the 28th of August Mr. John Milne, of Inverurie, Aberdeenshire, reported as follows:—"I enclose specimens of pupa found to be common in the joint or second knot of Barley in nearly every field in Aberdeen and Banffshire. They seem of various sizes. It is hoped they are not the pupa of the Hessian Fly, for, if so, it has got a firm footing in the Barley fields of the North of Scotland." The specimens accompanying showed only too plainly that the chrysalids were true Hessian Fly puparia. On the 29th August Mr. Milne further mentioned:—"I regret that traces of this insect can be found in every field along the coast from Aberdeen to Cromarty, and inland for twenty-five to thirty miles. I enclose a few specimens of Wheat-

straw from Urquhart, Morayshire. So far the ravages are not extensive, not more than one straw in fifty being affected, and on these the grain is of fair quality." . . . "In Aberdeenshire, Barley and a little Rye, besides Oats, are the only grain crops grown." . . . "If the 'fly,' does much damage in the future it may be necessary, if Barley is to be grown at all, that it be sown as a second white or grain crop, without seeds, and the stubble ploughed down as soon as the crop is removed." . . . "PS. I might have mentioned that I find a good many of the pupa-cases empty, showing that the perfect insect has already emerged."

August 26th. Mr. Robert Ironside sent me joints of Barley-straw, infested by Hessian Fly from Auchlassan Lumphanan, by Aberdeen, with the remark that, seeing many of the stalks kneed, he had examined and found the so-called "flax-seed," and likewise that he was "at a loss to know how it could have come there, as there was no foreign straw used, that he knew of, near the place."

OBSERVATIONS OF ATTACK IN THE SOUTH-EAST OF SCOTLAND DURING SEPTEMBER, 1887.

On September 1st I was favoured, by Mr. Malcolm Dunn, of Dalkeith, with the following observations, which are particularly valuable from Mr. Dunn's knowledge of insect-life and great accuracy and skill in observation, which have been much assistance to me now for many years; and I would particularly advise study of these notes, for they appear to me to give, in condensed form (that is, in the observations of one district), no bad idea of what the nature of the Hessian Fly attack has been in the infested part of the country at large.—ED.

Mr. Dunn wrote as follows:—

"I duly received your letter of the 16th ult., and I have delayed replying till I should have had an opportunity of inspecting the fields in the district infested with the Hessian Fly in East Lothian, and also around this neighbourhood, to see if I could find any signs of it. I have gone over many fields in the district around here, extending from Edinburgh to Tranent in East Lothian, and from the sea at Musselburgh to Penicuik, and nowhere have I been able to find any indication of the presence of the Hessian Fly. I have been told by several farmers that they 'had it among their corn'! but on examining 'it' I always found some other insect at work (generally the Corn Fly, *Chlorops tentopus*), but never the Hessian Fly. I am satisfied that it has not yet appeared in this district, or is so rare that neither I nor any of the keen-eyed entomologists about Edinburgh have been able to detect it.

"I went down to Drem, in the centre of East Lothian, and spent a whole day traversing the country between that and Dunbar. In twenty-seven fields of Barley, which I looked into, I easily detected the work of the insects, and found them in the usual place on the straws in twenty-one of the fields. In four more of them, after a little careful hunting, I found a few specimens of straw infested with the 'flax-seeds,' and in only *three* fields did I fail to find the insect, so that it may be said to be 'general' on the Barley in that district. I had little time to spare for a close search in the *Wheat* fields, but kept a watch on them as I passed along, looking into a good many, but not going far among the growing corn. In only two fields was I able to find the insect, and that on very few stalks next to Barley fields, which were rather badly infested. On the whole, I do not think it exists on the Wheat in the district to any serious extent. I am certain it is far from being so evident on the Wheat as it is on the Barley. The worst spot I saw did not contain more than a *dozen* infested straws to the *square yard*, carefully measured and counted. In fact the infested straws (or rather broken or bent straws, clearly infested with the puparia) seldom exceeded half a dozen, and on each straw the 'flax-seeds' varied in number from one to five; generally two or three.

"So far as I could judge from the appearance of the heads and the grains of corn, neither had suffered in *size* or *quality* from the attack. The straw was bent, and to that extent '*damaged*,' but not more so than we see it often after a heavy storm of wind and rain; and the *loss* from the *storm* in most instances would be far more than the loss from the Hessian Fly in this instance. So far as I can judge from what I saw in the Drem and Dunbar district, I believe the comparatively little damage done is owing to the late period at which the 'fly' began to multiply, and to attack the crops. The great heat we had in June would naturally give it a good start, but the Barley had nearly reached maturity in the end of July, before the attack *began in earnest*, if I may so term it. If this surmise is correct it is possible that our cold and raw or wet springs may always be effective in keeping the ravages of the insect within bounds in this country, by keeping back the attack to so late a period in the season as to make it comparatively harmless.

"I do not hear of this insect being found at a *high altitude* nor in *wet districts*, but of course it has hardly been long enough in the country to spread over all the parts where it may be able to exist. In several fields, in the upper parts of this county, I have failed to find the insect after the most careful inspection. The attack seems at present to be confined to the low-lying districts in the East of Scotland, and in proximity to places where it might have been readily imported from countries abroad infested with the 'fly.'"

NON-PRESENCE OF HESSIAN FLY ATTACK IN THE EXTREME NORTH
OF SCOTLAND.

In regard to presence of the Hessian Fly in the northern extremity of the island, I applied to Mr. George Brown, of Watten Mains, Caithness, to whom I have been indebted for many years for observations, and who is perfectly competent to form an opinion on the subject; and on Sept. 10th he sent me the following reply:—

“I have been on the look-out, but have never come across anything bearing the slightest resemblance to attack from these pests; and am pleased to say, so far as I can learn, Caithness is as yet free from a visitation.”

I was favoured also by Mr. Jas. Johnston, of Ophir House, Orkney, in reply to my inquiry whether the pest under consideration had been observed in the Orkney Islands, with the information that he had neither seen the Hessian Fly nor heard of it there.

THE FOLLOWING PARAGRAPHS REFER TO THE ONLY OBSERVATIONS OF THE EGGS OF THE HESSIAN FLY WHICH WERE REPORTED TO ME; TO THE FIRST APPEARANCE OF THE HESSIAN FLIES FROM THE CHRYSALIDS OF 1887; AND TO THE VERY IMPORTANT MATTER OF THE IDENTIFICATION OF THE HESSIAN FLY PARASITES.

First observation of maggots reared from eggs laid by the Hessian Fly.

The only observations sent me on this head were by Mr. D. Taylor (previously quoted), who mentioned to me, on August 22nd, that he had secured a few Barley plants with maggots of the *C. destructor* reared from the eggs. These he placed in the hands of Mr. S. L. Mosley, of Huddersfield, and he also forwarded some plants, with eggs on them, to myself; but, though it may fairly be considered certain that the flies were *about in the fields* during August, it was not till some days later that the first appearance of the flies from chrysalids of the summer brood, which had been taken from the fields and kept in captivity, was reported.

With regard to *method of deposit of the eggs of the Hessian Fly* on the blade of corn, Mr. Taylor further observed:—

“The fly goes about egg-laying in a business-like manner, with its head towards the point of the blade and the ovipositor extended in a kind of semicircle to reach the concave surface of the blade. After it has laid one egg it takes a flight round the blade and alights again at almost the same place to repeat the operation, until a row of very minute specks of a vermillion-colour is laid along the centre of the

blade. I could not say that it laid more than two eggs at a time without a change of position, nor how many it laid."

FIRST APPEARANCE OF HESSIAN FLY FROM CHRYSALIDS OF THE
SUMMER OF 1887.

The first appearance of the Hessian Fly from the "flax-seeds" of this summer's harvest was reported to me on Sept. 5th by Mr. Inchbald (in this case from a locality in Yorkshire). He wrote:—"I have bred one imago already from a field near Wetherby, and I take it to be the scout—the foremost scout—of the great army so soon to follow in its wake. I have two boxes full of pupæ, and these have not passed through the screening process. . . . The gnat reared is darker,—swarthier than those of the spring brood; it is a female, and I think slightly larger than those I have previously reared."

On Sept. 27th Mr. Inchbald further wrote that he had reared four specimens of the Hessian Fly—two males and two females—from pupæ obtained in August from the culms of Wheat and Barley in the neighbourhood of Wetherby. He observed:—"We find the nearest approach of the fly to the east coast of Yorkshire is Ellerby, near to Burton Constable. I have a *considerable* number of recently-gathered pupæ. I got them in the hope of being able to supply my many friends with living specimens before the winter. I now think they will keep in abeyance till May, if they be not pierced."

PARASITES OF THE HESSIAN FLY.

The parasites of the Hessian Fly, which we have at present observed in Britain, are the maggots of very minute four-winged flies, which lay their eggs on the maggot, or, it may be, on the chrysalis of the Hessian Fly, and, by means of the maggot from the egg preying on the pest in its early state, prevent large numbers of it reaching maturity.

The presence of these parasites is looked on in Hessian Fly infested countries as a very important help in keeping down the pest; and, on May 28th, Mr. D. Taylor noticed the greater proportion of parasites to "pest" developed from his puparia of Hessian Fly. In one bottle containing not more than fifty pupa-cases, at the above date, no specimen of Hessian Fly had developed, and about twenty-three parasite-flies had appeared.

That these parasites accompanied the Hessian Fly from the very beginning of the first observation of attack last year is plain (a specimen having been secured in September, 1886), and since then, as is well known to all readers of the agricultural or other journals, the

parasites have been notably observed to be present; and during the past season attempts have constantly been made, with greater or less success, to identify them, and thus, by finding whether they were of the kinds known to infest Hessian Fly in Russia or in America, to gain a clue as to whether it was from Russia or America that the attack came of the insect whereon they feed, viz., the Hessian Fly.

Up to the end of October, however, no certain conclusion had been arrived at, as most of those concerned (so far as I am aware), and myself amongst the number, identified, or endeavoured to identify, solely from published description, without knowledge gained from personal examination of either American or Russian specimens. Our best guidance was from the information kindly given by Prof. Riley, Entomologist of the Department of Agriculture of the United States, who, after long and careful examination of British specimens, at which I had the advantage of being present, stated that none of those submitted to him appeared to agree with specimens of the kinds known to him as North American; and that the points laid before him regarding the attack inclined him to consider it of European rather than American origin. I also myself, so far as I could form an opinion in such a difficult matter, have already mentioned that one of the specimens appeared to me to agree in essential points with the Russian *Semiotellus nigripes*, Lind.

Under the difficulties of identifying from description alone, I forwarded a small collection of parasites (bred from "flax-seeds" saved from the infested corn of the year 1886 by Mr. D. Taylor, of Daleally Farm, Errol, N.B.) to Dr. Charles Lindeman, Professor at the Academy of Agriculture, Moscow, who has devoted much attention to the study, both practical and scientific, of Hessian Fly in Russia, and has especially studied and written upon the subjects of its hymenopterous parasites. These specimens Dr. Lindeman had the great courtesy and kindness to examine carefully, and on the 31st of October I received the following communication from him, announcing that four of the five kinds he had examined were Russian; and with his letter he also sent a small collection of Russian specimens, truly valuable for our British service. Dr. Lindeman wrote me as follows:—

"I now hasten to attend to your communication sent to me with the parasites of the *Cecidomyia destructor*, and I have found the following species:—

- "1. *Semiotellus nigripes*, L.
- "2. *Tetrastichus Rileyi*, L.
- "3. *Merisus intermedius*, L. (var. *micropterus*).
- "4. *Platygaster minutus*, L.

"Along with these Russian species I find an example of what I am inclined to consider to be the American *Merisus destructor*. At least, it

is distinguished from my *Merisus intermedius* by the form of the body and brown shanks, and agrees well with the description by Riley."

The first four of the above parasites being Russian kinds, points to our attack of the Hessian Fly, on which the maggots of these insects feed, being certainly in part from Russia.

Whether the presence of the *Semiotellus* (or, as it is now called, the *Merisus*) *destructor* of Say, points to some part of our attack coming from America, does not appear to me so certain, because, although this is without doubt an American insect, it has also, under the synonym of *Ceraphron destructor*, Say, been recorded as parasitic on the Hessian Fly in Germany; and therefore it appears to me that this parasite may have come to us either from America or Germany. *Therefore the case stands at present that it is certain that four of the five kinds, which have been trustworthily identified, are Russian, and it is very possible that the whole of the attack has come from the Continent of Europe.*

On the 22nd of November Prof. Riley further wrote me that he had given two whole days to the examination of Hessian Fly parasites reared from British puparia, together with a collection of specimens of Russian parasites sent him by Dr. Lindeman, with the result that all the conclusions he had previously arrived at were confirmed. I give the list (by kind permission) of the species identified by Prof. Riley, which it will be seen includes the four species noted above which I had forwarded to Dr. Lindeman, and which were named by him as Russian, and likewise three other Russian forms:—*Semiotellus nigripes*, *Tetrastichus Rileyi*, *Merisus intermedius*, *Platygaster minutus*, *Eupelmus Karschii*, and *Euryscapus senilis*, all species of Lindeman; likewise *Dacnusa senilis*, Hal. (not a Chalcid). Thus Prof. Riley remarks, "Every one of Dr. Lindeman's forms have been reared in England, but I should not have been able to speak so positively without his types, which he has been kind enough to send me."*

Those who desire the latest and fullest information regarding these parasites are referred to a paper by Prof. C. V. Riley, Entomologist to the Department of Agriculture of the United States, "On the Parasites of the Hessian Fly," published in the 'Proceedings of the United States National Museum,' 1885, pp. 413-422, one plate. Also 'Die Pteromalinen der Hessenfliege' (*Cecidomyia destructor*, Say), by Prof. Lindeman, Moscow, 1887.

* As I have Prof. Riley's kind permission to give the information with which he furnished me, it may be of interest to some of the Hessian Fly observers to mention that he considered the *Semiotellus nigripes*, Lind., would probably be found synonymous with *Entedon epigonus*, Walker; that *Euryscapus saltator*, Lind., was *Euryscapus Degeeri*, as determined by Mr. Marshall; and that there were great varieties in the forms of *Merisus intermedius*; but as I believe that we may look forward to aid from Prof. Riley's skilled pen and pencil in putting the whole series of British parasites in order before us, I do not add more from the short notes he has kindly given me.

As the difficulties of the past year have shown that it is almost impossible to name these parasites from descriptions alone, I do not add any; but it may be of use to mention that these parasite-flies are so small that it is almost impossible to distinguish the limbs with the naked eye, and that they may be known from the Hessian Fly by this possessing only *one* pair of wings, whereas the parasites have *two* pairs, excepting in the few instances in which these are abortive.

OBSERVATIONS OF ATTACK NOT BEING FOUND PRESENT ON OATS.

Somewhat previous to July 27th a note appeared in one of the Scottish journals to the effect that a field of *Oats* in Brechin district had been badly injured by Hessian Fly. As the *Cecidomyia destructor* has hitherto not been known to injure the Oat-plant, further information and specimens were requested, but nothing further, so far as I am aware, transpired on the subject.

Later on, that is, on August 11th, I received information from Mr. Thomas Bunker, of Goole, as follows, and desire particularly to draw attention to it relatively to it showing non-presence of the pest on Oat-plants, even when the Oat-plants and infested Wheat-plants were growing close by each other. Mr. Bunker is acquainted with the appearance of the "flax-seeds," and forwarded confirmatory specimens. He observed:—"I regret to state that further researches have shown the Hessian Fly to be firmly established in this neighbourhood. Mr. Riley, of Hesse, came here last Monday, and we spent a few hours visiting some of the fields infested.

"In one field crops of Wheat and Oats were growing side by side. We thought it a good opportunity for testing the statement that the fly does *not* attack Oats. I have since found many Wheat-stalks attacked within a foot or two of the Oats, but failed in finding it on the latter plant, though I spent an hour and a half in the search. The leaf or sheath of the Oat fits so loosely on the stem, compared with that of Wheat, that I think it does not give the necessary shelter and protection to the larvæ.

"Very little Barley is grown in this district, and I have therefore had no opportunity of examining it. A farmer told me yesterday that there was not a Wheat-crop on either of his farms (more than two miles apart) that was not infested. He farms 500 or 600 acres."

On August 22nd Mr. Bunker sent me the following further report, accompanied, as before, by specimens of the "flax-seeds":—

"On the 15th I again tested the non-presence of the Hessian Fly on Oats. I was at Balne, a small township nine miles from Goole. The crop consisted of Wheat and Oats mixed. I was able to find the chrysalis on the Wheat, *but in no case on the Oats*. I enclose two specimens."

The following observations were chiefly sent to me in reply to my inquiries as to amount of damage, and also as to varieties of Wheat which, though attacked, were little injured by presence of the pest:

On September 24th Mr. John Milne, of Inverurie, Aberdeenshire, favoured me with the following reply to my inquiry regarding Wheats which were found to "resist attack":—

"You ask if I can give the names of some of the Wheats that have the attack of fly, but yet do not suffer severely. . . . There is now no Wheat grown in Aberdeenshire. In Morayshire the variety is chiefly 'Square-head,' a strong-strawed yellow Wheat. As far as my observation extended, I could trace the fly in each field by the bent stalks, but the damage so far did not seem to be great, as the bent heads seemed fairly filled with grain. In Aberdeenshire a good deal of Barley is grown, and also a six-rowed variety called 'Bere.' I have seen it stated that the 'Bere' crop was uninjured, while the Barley alongside was attacked; but I have been unable to confirm this by personal observation."

Oct. 15th. Mr. H. Lindsay Carnegie, of Kinblethmont, Arbroath, replied:—"I found the fly in nearly every field of Wheat near me, but not to any serious extent. Wheat here is nearly all winter-sown, and of the white variety. I searched several fields of Rye, but found none at all in them, *nor in any of the Oat-fields*. Barley was decidedly the most affected of all the cereals. . . . From the very early harvest very little damage was done in reality, as the grain had filled before being cut over."

Oct. 15th. Mr. John Norwood replied to my inquiries from Bulby, Bourne, Lincolnshire:—"The kind grown on Lord Aveland's farms here is 'Square-head,' a hardy red Wheat. The field in which 'fly' was most numerous has been threshed, and yielded 88 bushels per acre, scarcely so much as I expected; but still a very fair yield for poor strong land. I certainly could not estimate the loss caused by 'puparia' at more than one bushel per acre.

"My opinion is, had the weather not been so dry and fine for ripening, the ears on broken-down stalks reclining on the ground would have suffered severely; but the absence of rain and the hot dry state of soil enabled broken-down ears to fill almost as well as the others, and almost, if not quite, as good quality of grain. In 'rubbing-out' grain from the broken-down ears I noticed little difference in quality compared with the erect ones, but a slight diminution in quantity, not being so well filled. Had the season been wet the deficiency must have been much greater. In a neighbour's field in this parish, growing a largely advertised variety of White Wheat, I estimate the loss at a higher figure, certainly two to three bushels per acre; and I do so from having noticed the broken-down ears very badly filled. I may say I

have seen no Wheat this year that is what is locally termed 'root-fallen' or 'storm-broken,' and that the broken-down ears are solely attributable to attack by Hessian Fly.

"In a twenty-acre field of Barley, in which 'puparia' were very plentiful, being gathered at every step, I noticed none of the ears broken down were so large as the erect ones, or so well-filled; the crop is not yet threshed, but, judging from the quantity and appearance of attacked ears, there must be a deficiency of three bushels per acre. Many of the broken-down ears were left on the ground by the reaper, and not all gathered by the horse-rake."

On Oct. 10th, relatively to amount of attack, Mr. Riley mentioned as follows:—"I found it all over the East Riding of Yorkshire (more or less), especially in Barley; in many places it would have done serious damage had the attack appeared a month sooner; fortunately the corn had begun to ripen before it came. I noticed that on land well farmed, as also on warp land, the Wheat was little worse in the sample, and that many of the stalks of corn that had the 'flax-seeds' in had not fallen down, showing there was sufficient support to carry the ear on."

Oct. 18th. Mr. G. Palmer, Revell's Hall, near Hertford, favoured me with the following information:—"With regard to damage to the Wheat, I observed, both this year and last, that it was very slight, and one had to search about a good while to discover a stem injured or bent down. On the other hand, you can stand in the Barley and see ten or a dozen at once. I think there is no doubt that the stiffer the straw the better the attack is resisted. We had this year about twenty acres of the 'Square-head' Wheat, which grows a very stiff straw, and I was unable to find any injury done to it; while there was some (although very slight) done to a field of weaker kind of straw adjoining. I do not consider that we had so much damage done to our Barley this year as last, although there was a large amount of Hessian Fly puparia in the straw. I can account for this from the fact that we grew a Barley with a very stiff straw, and it was not till the grain was pretty well matured that the stems attacked gave way, consequently the Barley in the injured stems was of nearly as good quality as those not attacked. In future we shall always grow this kind of Barley."

Oct. 18th. Mr. J. C. Swann replied, from Manor Grange, Long Stanton, Cambs:—"The specimen I found and sent you of the Hessian Fly was from a Barley-field. I have just threshed the Barley out, and found it excellent quality, but the yield excessively poor. I may add, for your guidance, the land is wretchedly poor and foul, and will lie for a fallow next year. . . . I did not find it in my Wheat-crop at all."

The Professor of Agriculture, Hollesley Bay, mentioned:—

"The early-sown Barleys I have found to be more affected than those got in later—during the first fortnight in April."

Oct. 21st. Mr. D. D. Gibb, replying from Thorn's Farm, Lymington, Hants, gave some information well worth considering regarding effects of manures, as well as regarding kinds of Wheat. He noted, as his experience of Hessian Fly attack on the farm:—

“Barley may be termed the chief sufferer: in two Wheat-fields adjoining Barley affected I failed to find proof of Hessian Fly, but did of sawfly. These varieties of Wheat were stiff-strawed, *viz.*, Ambrose's ‘Stand-up White’ and Webb's ‘Square-head Red.’ The ground was well-manured also, top-dressed in spring with salt and nitrate of soda. This Wheat was after Clover-lea, second growth fed off with fattening sheep, afterwards receiving say about fifteen tons farmyard manure. One field sown with ‘Webb's Challenge White Wheat’ not after Clover, but getting quite as much (say twenty tons) farmyard manure,—did not get the top-dressing: this looked well and healthy, so far as my observation went, all winter and spring, but suffered severely from attack of Hessian and sawflies. The ground was a poor sandy loam lying close to the edge of the Solent, and the season was altogether too dry for it to produce a crop. Barley top-dressed in a similar way, and with kainite, superphosphate, and sulphate of ammonia, showed less sign of attack than where not top-dressed. I was therefore led to the conclusion that whatever manure causes vigour of growth and gives stiffness to the straw lends the plant strength to better withstand an attack, except in very bad cases, and when mixed with weed-seeds.

“Some stubble which could not be burnt at the time was carried into a yard and well trodden-in by fattening steers. I also have suggested the addition to this of gas-lime, which will at the same time render the mixture more pungent, and increase the manurial value.”

Oct. 24th. Mr. W. Gillespie, in reply, added to previous information from Athelstaneford, Drem, N.B.:—“My Wheat was in no way damaged; the variety ‘Square-head.’”

Oct. 26th. Mr. A. J. Witcher, writing from Peckworth Manor, Stamford, said:—“I have not noticed any Hessian Fly in the Wheats; variety grown, ‘Square-head White Chaff.’” Some fields of Barley have been greatly damaged. I found the later-sown Barleys much more heavily attacked by Hessian Fly than the earlier-sown. I also found that Barley grown on land that was Barley the previous year was very much more attacked than the Barleys grown after Turnips and Clover.”

Oct. 27th. Mr. John Hardwick, Agent to Sir John Thorold, of Syston Park, Grantham, wrote in reply:—“The usual kinds of Wheat sown in this district are the ‘Square-head’ and the ‘White Chaff Red,’ but more particularly the latter; and have not heard of any case where they have been attacked by Hessian Fly. The Barley-crop has been attacked, but not to any appreciable extent, about here.”

Oct. 27th. Prof. W. Fream, writing from the College of Agri-

culture, Downton, mentioned that the Wheat in which he found the Hessian Fly on the farm was 'Square-head,' but no interest or trouble was taken generally in the neighbourhood, excepting by himself and students, and he inclined to think that the attack was light.

Oct. 28th. Mr. Francis Shaw, of Brant Broughton, Newark, amongst other points deserving notice, drew attention to the amount of Wheat which had been drilled early this autumn, a matter which will be very desirable to watch effects of relatively to possible encouragement thereby of autumn brood of Hessian Fly. Mr. Shaw notes :—

"Next year will prove to us if it is to be dreaded to the extent some writers represent, as there will be an abundance of Wheat-plants this autumn upon which it can deposit its eggs, for I never knew so much Wheat drilled so early as this year; in several fields where it was drilled in September the Wheat was up in a few days. The kinds of Wheat which resist the attack of the fly the best are those which grow a stiff reedy straw, of little value as food for cattle, such as the 'Golden-drop,' the 'Square-headed Red,' 'Chaff Red,' and 'Rivett's Red.' The Barleys which grow the stiffest straw, although a very coarse grain, are the 'Awnless,' Webb's 'Kinver,' and the 'Battledore.' Those who are farming a poor weak soil have the most to fear from an attack upon their Barley. Here, where the soil is above the average, it would have been a difficult matter this last season to prove a loss from the fly, although it was discovered in many fields. I looked for it in vain in fields growing the 'Golden Drop' Wheat. My reason for thinking we have had the fly in this country for some years is from having seen the Wheat lying in the same position, at an angle of twenty degrees different years, without knowing the cause."

On Nov. 16th Mr. Andrew Spence, of Mountboy, Montrose, N.B., replied:—"Most of the farmers in this district sow white Wheat. Both they and the others who sow red Wheat agree that there has really been very little damage to the Wheat-crop by the fly."

The following note, with which I was favoured by Mr. W. Formby, sent on Dec. 7th from Morningthorpe, Long Stratton, Norfolk, gives one of the very few returns I have been able to procure regarding amount of loss on attacked crop. Mr. Formby mentions :—

"I am now able to say my Wheats were very little damaged. I only grew one sort the name of which I know not, but it is a red Wheat growing a lot of straw of a very strong nature. All my Barley-fields were attacked by the fly, one field in particular yielding four sacks an acre less than the rest of the Barley I have threshed up to the present time. I may say the field named was drilled with bought seed, and grew a finer straw than the rest of my Barleys, which in this neighbourhood is known as 'Archer's Barley,' and certainly gives me the

idea of resisting to a great extent the attacks of the fly. 'Archer's Barley' I have grown for several years, and find it grows a large quantity of straw of a strong nature (this might not be the case on lighter land); the grain also is large."

NON-PRESENCE OF "FLAX-SEEDS" IN IMPORTED STRAW AND SWEEPINGS OF SHIPS.

With a view to ascertain whether the pest was being introduced on imported straw, careful watch was kept, and examination made, by qualified observers from time to time during the spring months, at Dundee, Leith, and Granton, Hull, Goole, and other localities mainly on the east of Britain. The search was carried on by opening out bales, examining sweepings of straw-ships, and also by gaining permission to have a watch kept at stables and other places whither the imported straw was conveyed for use.

Specimens of seeds, &c., were successively sent me for identification, so minutely resembling the flat seed-like chrysalis-case of the Hessian Fly as to show that the observers were well acquainted with the appearance of the so-called "flax-seeds," but only one true specimen was found. This was on a corn-stalk *grown* in Belgium, which is singular enough, as Belgium is one of the countries which is considered to be free from presence of the pest.

I keep the various communications for reference, if necessary, but, as in some cases my co-operators did not, I believe, wish their names to appear, I only express my thanks here for a great deal of long-continued trouble taken to Mr. D. Taylor, jun., of Daleally, Errol; to Mr. Edm. Riley, of the Weir, Hessle, near Hull; and I have particularly to express my thanks to Mr. Halls (of the firm of W. Halls and Son, the large straw importers in Hull) for the courteous and very great assistance they have given in allowing the straw to be examined, and the sweepings of the ships saved for inspection, and in directing the men to give every assistance in their power. I am also much obliged to Mr. John Bennett, of Goole.

On May 18th Mr. E. Riley, who had bestowed much care on the subject at Hull, wrote, after some weeks' attention and inspection:—"I have examined some thousands of bales of straw at Hull and Goole during the last four weeks, from Harlingen [in the Netherlands, Ed.], Dunkirk, Hamburg, Rotterdam, and Boulogne, but have not found the slightest trace of chrysalis of Hessian Fly."

The stevedore at Hull [who was well acquainted with the appearance of the "flax-seeds"—Ed.] has taken great pains in having all the sweepings of the vessels thoroughly examined.

On August 12th, my co-operator, near Edinburgh, reported:—"I have been keeping a close look-out all the season for the dreaded

Hessian Fly, and a very close watch has been kept on all imported straw at Leith and Granton. Still we have failed to detect anything like the enemy in *this district*, or on the *imported straw*."

I give the above short abstract of the information forwarded to me to show the care that was bestowed upon the subject, and also that, from such a small body as a single puparium being found, and likewise the many specimens very much resembling "flax-seeds" which were sent me for inspection, it appears to me certain that if the chrysalids of Hessian Fly ("flax-seeds" as they are called) had been present, they would quite surely have been noticed. But at the same time I do not consider that their non-appearance militates at all against all possibility of infestation being sent us from *infested* countries, because (so far as we know) the straw we examined was mainly from countries where attack, even if present at all, is not prevalent.*

We have, however, learnt, from the minute and skilled examinations, the valuable practical point that a large amount of the straw coming into the country is not infested; and, with regard to what further may be needed, it appears to me that what is wanted (now that we know that Russian parasites to be present in the country) is for receivers of Russian straw (and corn, if not properly cleaned), and for their customers, to give due regard to the matter.

Attention as to consequences of using cheap, foul screenings is much needed. As far as one year's experience shows, Hessian Fly here is not so injurious as at least two other of our regular established corn-pests, whose attacks have been quietly submitted to for many a year without even an attempt worth speaking of being made to get them under. But I would most strongly urge on all agriculturists, and on all importers of grain, that they should insist on it being sent to them properly cleaned before shipping, and also that the sale of the foul rubbish teeming with insect-vermin, weed-seed, ergot, and useless dirt not even valuable as a manure, should be by every means discouraged.

METHODS OF PREVENTION.

Destruction of "flax-seeds" found (after threshing infested straw) in siftings or light grain.

One method of quite certainly lessening the amount of coming attack is by destroying the "flax-seeds" which are to be found (after threshing infested straw) in the siftings, and also sometimes in the light grain.

Where the screenings are merely of dust, rubbish, and weed-seeds, it would be little trouble or loss beyond cost of labour to have them burnt, or by any other more convenient way thoroughly destroyed;

* For further notes on straw imported from Russia see Appendix.

and where they are in the light grain, this should be cleared so as to prevent the "flax-seeds" being distributed with it.

In a letter from Mr. D. Taylor, of Daleally, on April 3rd, 1887, when this subject was under special consideration, he mentioned:—"We are boiling those 'flax-seeds' which are amongst the shag along with it, and feeding our horses and cows with it; the weeds and dirt are promptly destroyed." But in whatever way each owner may think fit to manage it, the matter of destruction of these "flax-seeds" is highly important, or in due season the insect-pest will be likely to hatch out and start new attack. Whether these chrysalids or "flax-seeds" have their vitality destroyed by being swallowed along with the light-grain food of the horses and cattle does not appear, but, judging by what happens in other cases, I should think it at least quite possible that being passed through the animal in the process of digestion did them no harm.

Prevention by ploughing in, or by burning infested stubble.

With regard to such amount of "flax-seeds" as may be left on the land, either on infested stubble or fallen therefrom to the ground, there does not appear to be any way of getting rid of these excepting by such ploughing as will bury them thoroughly down, or by burning the stubble.

In the case of deep ploughing, what is wanted is to skim off the infested surface and turn it over, and then bury this thoroughly down by another land-slice.

If the Hessian Fly chrysalis-case (that is, the "flax-seeds") are put (before the perfect fly within them has begun to form) in unnatural circumstances, it has been found, scientifically as well as shown in the previous observations, that the hatching-out of the fly may be delayed for many months,—indeed until the middle or end of the following summer. Therefore, if we bury the chrysalids well down, we may thoroughly expect to get rid of any present continuation of attack from flies out of these, and in all probability to get rid of them altogether. But if only common ploughing is done, and the edges of the land-slice left running in ribbons of stubble and weeds exposed to air and light, on the back of the previous one, then what "flax-seeds" may be there will be little injured, and will be likely to give out their pests in due season.

Whatever kind of plough, furnished with a skim-coulter, will effect the double work of first skimming and then burying the slice will answer the purpose.

Burning infested stubbles.

Where nothing further can be done it is at least desirable, directly after harvest, to skim infested stubbles and drag the rubbish

and burn it. Thus all of the pest that may be left will be destroyed; and this year's experience has shown that the "flax-seeds" may be found *at the ground level*, and at the first knot, as well as at the second knot, and higher yet.

Where complete firing of the stubble can be safely done (and I saw, after last harvest, in many cases that this could be carried out) the plan is very desirable, and not only is destructive to the pest under consideration, but also destroys the maggot of the Corn Sawfly in the stumps of the stubble, which Sawfly maggot is, as far as I see, a greater evil to us than the Hessian Fly, and the attacks may very likely occur together.

But in burning stubble it is not right to let the fire go wildly as the wind may drive. The right way is to fire the field at the borders first. Thus there is only a slight warmth at first, and a line of fire quite under control near the hedges. The fire, as it spreads, draws towards the middle of the field, and, however the wind may drive, the flames cannot return over the already charred surface.*

Treatment of infested straw after threshing.

In regard to infested straw taken off the field, I am informed by Mr. John Martin, of Albion, Illinois, U.S.A., who has devoted much attention to the study of the Hessian Fly, that it is found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow; thus a very great proportion of the flies which come out of the "flax-seeds" are destroyed, simply because they are not able to get to the outside of the stack.

Late sowing of autumn wheat.

This is a point that great stress is laid on in American practice, and it is especially recommended in the United States (where autumn Wheat-sowing runs earlier than with us) that Wheat should not be sown until after the 20th of September in the Northern States.†

In this country this remedy is applied for the most part in regular process of farming arrangements; commonly our Wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

It is a quite plain thing that if, when the flies come out from the chrysalids, there is nothing suitable for them to lay their eggs on, that either the eggs will not be laid or the maggots from them will be starved to death; and *I believe that it is very probably to this point of*

* For the above hints I am indebted to Professor Hoyes Panton, of the Agricultural College, Guelph, Canada.

† See Third Report of United States Entomological Commission, Department of Agriculture, p. 221, 1880—82.

Wheat-sowing being late that we owe being preserved from the portion of the attack to the Wheat as a young plant, which, I am informed by Prof. Riley, Entomologist to the United States, is one great part of the damage in that country.

It is bad enough to have attack bred out of the previous year's "flax-seeds" to the growing Wheat in summer, but, if we are spared the other half by late sowing in autumn, it should be urgently brought under notice of all concerned that they should scrupulously hold to this means of prevention, which can be carried out usually in regular course.

Many kinds of measures which possibly may be of use in lessening effects of attack of Hessian Fly require no comment in a Report of the past season's work, as no notes have been sent of anybody having tried them; but sound and trustworthy reports from practical agriculturists have shown that the amount of mischief caused by the pest is influenced by the state of the crop. It stands to reason, where loss is caused by straw elbowing down, that, if the straw is so strengthened by cultivation, or of such a firm strong nature that it does not give way under a moderate amount of injury, we must benefit.

From the comparatively small amount of damage done to our Wheats there seems reason to hope that, either from our climate or soil or the kinds of Wheat generally grown, this crop may not suffer as it does in other infested countries; and in the coming season the point of the kinds and condition of the Wheat and Barley crops which may best resist attack will be one of the points which it will be desirable to notice.

Amongst various places where supposed presence of Hessian Fly proved on investigation to be that of some other corn-pest, it may be well to mention that which was reported to be so severe on land at High Legh, Cheshire, that in the words of one published description the crop might have been carried away "in a wheelbarrow."

This being a matter of great interest, the field was examined by Mr. B. Kendrick, of Warrington, Hon. Curator for Entomology of the Warrington Museum, who favoured me with full details and specimens accompanying, by which it appeared the attack was not of Hessian Fly, but of the *Chlorops tenuipus*, the small fly of which the attack was so often taken for that of Hessian Fly during the past summer.

From the two figures now given for examination side by side it will be seen that these attacks (when once their appearance is known) may be very easily distinguished from each other.

Straw attacked by Hessian Fly maggots elbows sharply down (as we all know) above the attacked part, commonly above the second joint. The Hessian Fly maggot does not feed in the ear, nor does it feed along the outside of the upper part of the stem. This is what the *Chlorops*, or "Ribbon-footed Corn-fly," does.



H. E. — E. G.

FIG. 1.

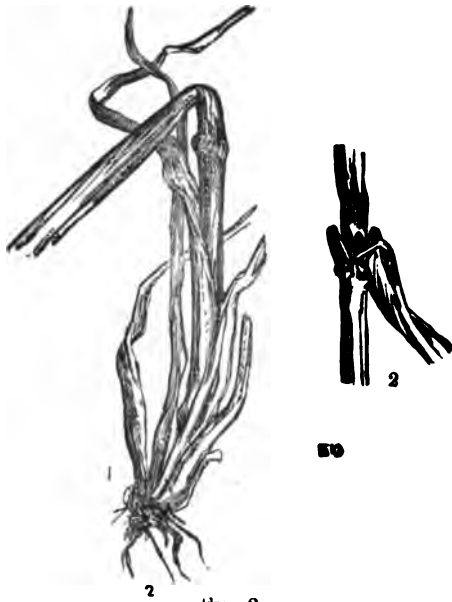


FIG. 2.

Fig. 1.—Barley ear and stem, showing *Chlorops* attack.

Fig. 2.—Barley stem, showing Hessian Fly attack. 1, bent down; 2, showing "flax-seeds."

The *Chlorops* is a small stumpy black and yellow two-winged fly, about the eighth of an inch in length; it lays its egg on the lowest part of the ears whilst the plant is still young, and, by the feeding of the maggot hatched therefrom, the lowest part of the ear is injured, and a blackened channel formed from the ear to the uppermost knot. This blackened groove runs down one side of the upper part of the attacked stem; but, besides this, the plant is often so stunted in growth and weakened that the ear is unable to leave the sheath.

Such an enormous quantity has been published from various sources regarding Hessian Fly attack during the last season that I have thought it best, in the above pages, merely to give the information which has been sent to myself in the senders' own words, so far as in me lay; and it will perhaps be most serviceable to present it just as it stands for readers to draw their own conclusions.

The two accompanying maps are merely added to give a general idea of the infested district. The localities which have been reported to myself, with specimens accompanying, and a few others which I have been informed of by competent observers, are distinguished by circles O or by groups of circles; the districts where the attack appeared in 1886-87 are marked by a black spot ● (of which one will be seen in England and three in Scotland); where present in 1886 only, by a square mark □; places where attack has been mentioned as present, but of which I have not personal knowledge, are marked by a cross ×; but, from the small size of the maps, the localities can only be generally indicated. From information received since the special reports were sent in, the East Riding of Yorkshire should be added to the infested district.

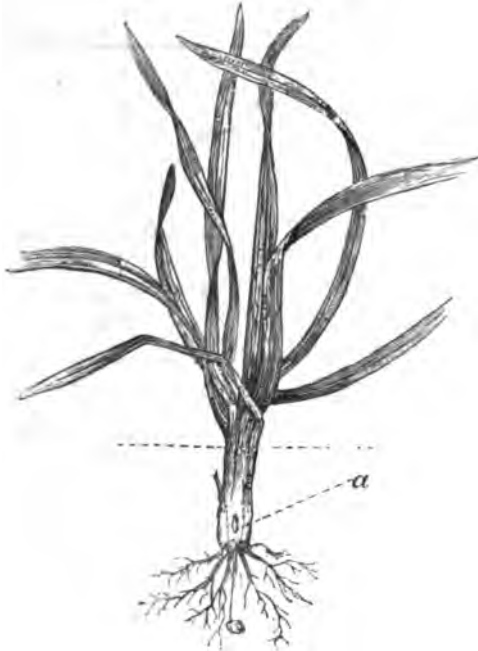
NOTE.—*Hessian Fly in young Wheat.*

At present we have no reason to suppose that we suffer at all from attack in the young Wheat-plant, but we cannot be too much on our guard. The following observations by some of the best known observers show the general points of the attack to the young plant:—

In the Report on Hessian Fly printed in Bulletin 4 of the United States Entomological Commission it is stated that "the worm in autumn lies at the sheathing base of the leaves just above the roots, at or near the surface. . . . The worms before assuming the flax-seed state rest between the leaves and the stalk," and the suction of the sap by the maggots causes the plant to become unhealthy, and to turn yellow and die.

Dr. Lindeman also, in his work 'The Hessian Fly in Russia,' mentions that the maggot living in the axil of the leaf bores holes in the tender little stem of the young plant, and thus deprives it of sap; but he notes that the leaves of the attacked plant die off at one time, "commonly losing little of their green colour."

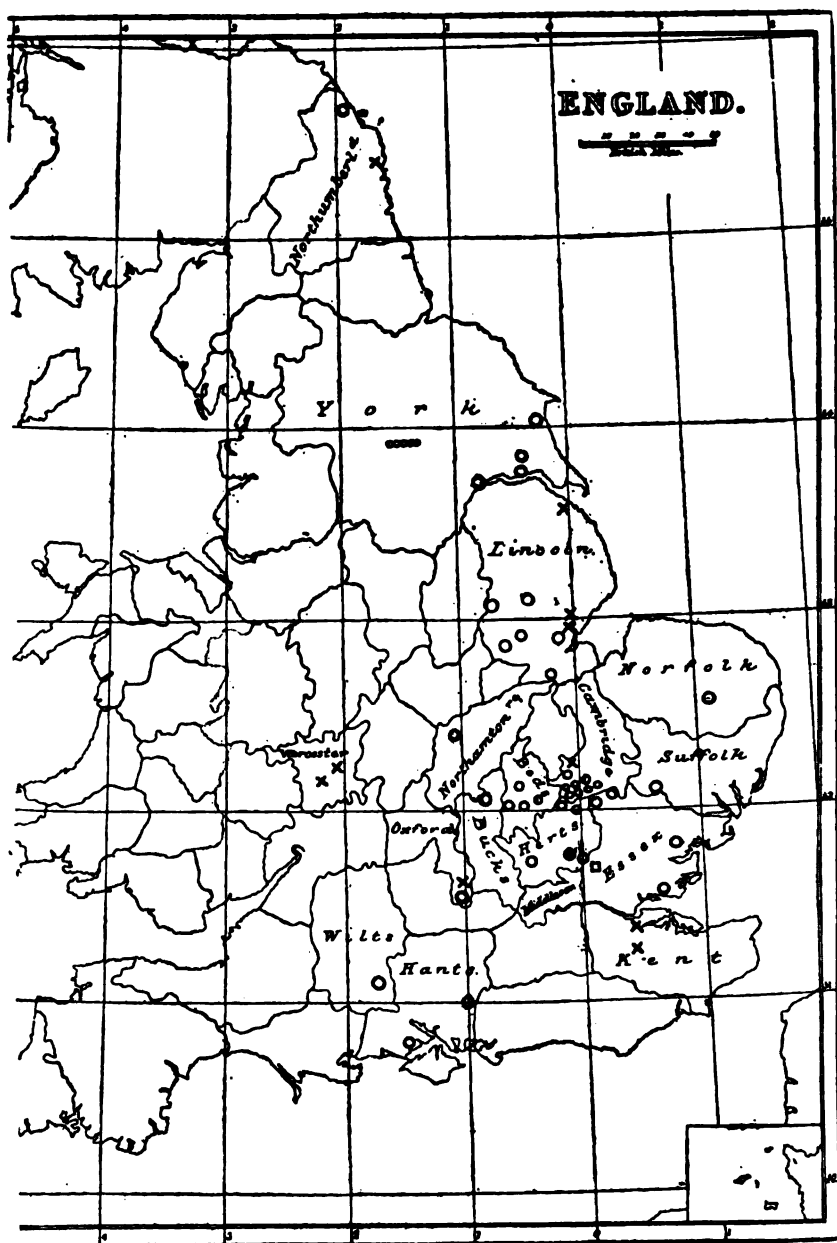
Prof. F. M. Webster, of Lafayette, Indiana, U.S.A., who has especially studied the subject of winter presence of the larva for the last three years, considers that it may be detected by peculiarities of the growth and colour of the infested plant. Whilst these pages were passing through the press, I was favoured by him with notes on the subject, of which I give below some parts (together with the accompanying figure), as follows:—

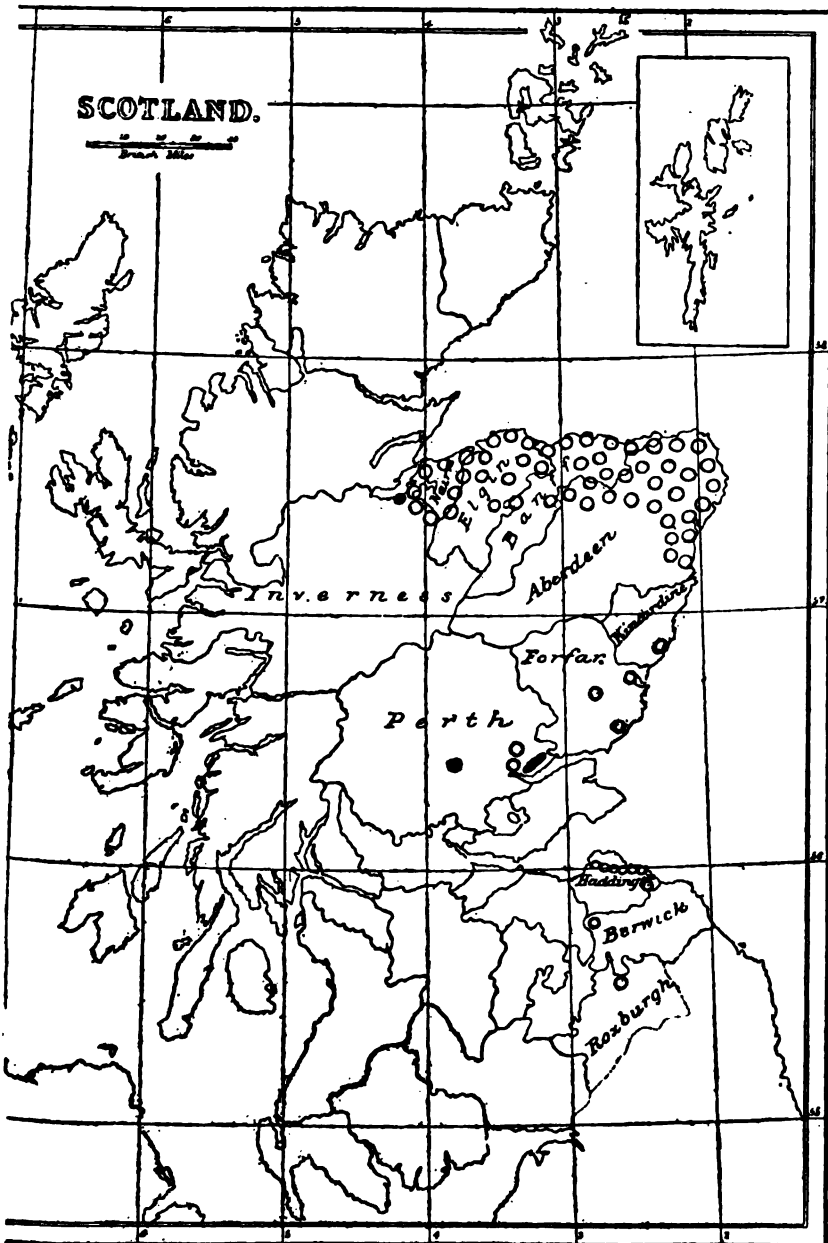


Plant of young Wheat, showing position of Hessian Fly maggot at "a."
(After Prof. Webster.)

"The above figure represents a Wheat-plant affected by Hessian Fly, the flax-seed or pupa being shown at *a*, where the insect is now to be found, just under the sheath of the plant. If the insect has not advanced to this stage of development, they will be of the same form, but of a whitish colour."

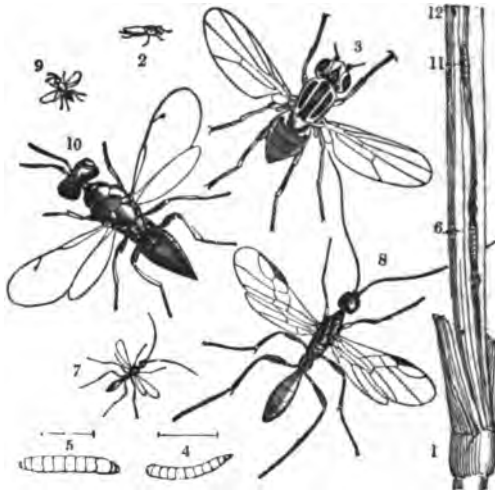
"The plant itself has not tillered, the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf, and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infested plant from one not injured. The yellow colour of some leaves is seldom observed, at this season of the year, on fly-infested plants." — From circular by Prof. Webster on Hessian Fly maggot-attack to young Wheat.





The above notes all agree in what is the important point, namely, that the maggot is to be found under the sheath, or at the sheathing base, or axil of the leaves of the young plant; and I think it is to be gathered that change of colour to yellow or to dead green does not take place until the mischief is done. Further points are open to enquiry; any information as to presence on early-sown Wheat or Barley would be very useful, and I should be greatly obliged by specimens of suspected plants being forwarded to me.

Ribbon-footed Corn Fly. *Chlorops teniopus*, Curtis.



CHLOROPS TENIOPUS.

2—6, Maggot, chrysalis, and fly of *Chlorops teniopus*, nat. size and magnified. 7 and 8, *Calinus niger*; 9 and 10, *Pteromalus micans* (parasite-flies), nat. size and magnified; 1 and 12, furrowed and infested corn-stem.

So far as may be judged by the reports sent in, the most destructive corn-stalk attack of last season was that of *Chlorops*, and the injury was certainly much more decided than that caused by Hessian Fly. This attack has long been known in this country, certainly as a crop-pest as far back as 1887.

So far as my opportunities for search have enabled me to tell, it is usually more or less present, and about eighteen years ago I myself shook the black and yellow fly in immense numbers from a stack in West Gloucestershire by simply thrusting my hand into the infested Barley-stack, and drawing out handfuls of straw and shaking them over a large sheet of paper.

This attack is demonstrably no new one, but it has been quite exceptionally severe in the last season, owing conjecturally to the exceptional heat and drought.

This "Ribbon-footed Corn Fly" is a small two-winged black and yellow fly, of the size figured above, and appearance as figured magnified. The injury is caused by the maggot hatched from the egg, deposited whilst the plant is yet tender, gnawing its way down from the ear to the first knot, often causing considerable damage to the lowest grains, and frequently so stunting the growth that the plant remains low and sickly, and without power for the ear to free itself from the sheath. But the special mark by which *Chlorops* attack may be known is the long, black, irregular furrow showing the track of the maggot outside the stem (see accompanying figure). The maggot changes to chrysalis on the plant beneath the sheathing leaf where it fed, and, as the fly soon emerges, it may sometimes be found in legions in fresh stacks of Barley.

On July 8rd Mr. J. G. Mann, writing from The Grange, Bishop's Stortford, Herts, mentioned:—" *Chlorops tenuipus* swarms in my late Barley, and also in my neighbour's. I also went into North Essex and South Cambs. last week, and found it there in all the late Barley . . . this has done much harm. Also on the above day (July 23rd) specimens of Barley-ears attacked by *Chlorops* were sent me by Mr. Richard Fowler from Broughton, near Aylesbury, Bucks, with a note that the crop was very much broken."

A communication was sent to me on July 21st, from Wilstead, Bedford, by Mr. James Newman. He mentioned:—"I have enclosed in the box some ears of Barley, in which you will find an insect eating the stem, and also up to the ear and stopping its growth; and six more in the small paper parcel, taken out of other ears. I find a great many more in late-sown Barley than in early-sown. . . . I was over a large field of Barley yesterday, thirty acres or more, and more than half had stopped growing by this insect."

On July 26th a parcel of Barley was forwarded by Mr. Towse, of The Avenue, Streatham, showing attack



H.E.—E.O.

Stem of Barley attacked by *Chlorops*, showing blackened maggot-channel.

of the *C. taniopus*, but which had been attributed to that of the Hessian Fly. Mr. Towse mentioned that he had visited several farms in Essex and Hertfordshire, where he had found the Barley attacked in every direction. He is of opinion that the pest is more to be feared than the Hessian Fly.

During August many enquiries were sent in, with specimens accompanying. On the 8rd a sample of attacked Barley was sent me from Heyford Hills, Weedon, by Mr. John A. Hardy. On the 9th a sample from Gowan Mains, Girvan, N.B., was sent by Mr. J. M. Hannah, with a note that the attack was "very materially lessening the chance of a crop." On the 11th similarly attacked Barley was forwarded by Mr. C. Manners Norman from Peckleton Manor, Hinckley; and on or about the 12th I received specimens of Barley, injured by this same *Chlorops* attack, from the Park Farm Office, Woburn, Beds, sent by Mr. J. B. Woodforde.

On Aug. 13th three applications were sent, with specimens accompanying; one from Mr. C. Magniac, of Colworth, Bedford, as showing "a pest—new to us—which is doing great damage to the Barley." "The grub seems to eat downwards to a joint"; a parcel of Barley was also sent from Little Welnetham Hall, Bury St. Edmunds, showing attack of the same kind, with the brown chrysalids also accompanying. About four acres in the middle of a seven-acre field were stated to be like the sample sent, the remaining three acres being sound and good; and on the same day a note was sent me by Mr. Francis E. Frazer, with specimens of *Chlorops*-injured Barley, from the Experimental Farm, Woburn. Mr. Frazer mentioned that the Barley was attacked by an insect which was doing considerable damage; "the infested plants do not come out in ear properly, as they never leave the sheath."

On Aug. 16th two parcels of straw, both of which proved to be injured by *Chlorops taniopus*, were sent from the Bedford Estate Office, Bedford, by Mr. Herbert Fenning; and on the 19th chrysalids corresponding with those of the *Chlorops* were forwarded by Mr. Joseph Martin, of Highfield House, Littleport, near Ely, from a Barley-field on one of his farms in the parish of Hilgay, Norfolk. On the 19th Mr. Ardron, Secretary of the Leicestershire Agricultural Society, Syston, Leicester, forwarded heads of Barley attacked by the same insect.

On Aug. 22nd Mr. C. J. Maxwell Lefroy forwarded a sample of Barley from Crondal, Hants, similarly attacked, with a note that much damage had been caused to a large field of Barley. "The soil is light loam or chalk; prior crops, Sainfoin for five years, then Oats; land 'steamed,' and 4 cwt. artificial manure to the acre."

On the 24th specimens of *Chlorops*-injured Barley were forwarded by Mr. James Carter from Burton House, Masham, with a note that

the farmer who sent them had about 500 acres of grain crops, and a great deal of his Barley appears to be affected. On Aug. 29th specimens of the same attack were sent me on Barley-stems from the Estate Offices, Ashby-de-la-Zouch, by Mr. John Gorman, with an observation of the damage being noticeable at the highest joint beneath the ear, and also that a husk or skin (that is, the chrysalis-case) was left behind in each stalk. The small brown chrysalids, or chrysalis-cases, are very often to be found lying in the blackened channel (see fig.). They are distinguishable by their cylindrical shape from the Hessian Fly chrysalids.

Specimens of quite unusually bad attack of *Chlorops taniopus* were sent me on Aug. 30th from Bettinge, Herne Bay, by Mr. W. S. Solomon. The ears were mostly still in their sheaths, and the stems were short, some seven to nine inches high, one only about six inches in height. This Barley was grown after Wheat which had been entirely destroyed by "the maggot" in the spring. The observer remarked that he had first seen Barley affected in this way four or five years ago. Chrysalids and cases taken from the straw were sent with the specimens.

On the 30th of the month ears of Barley taken from a field one mile from Pocklington, York, were sent me by Mr. T. Browne (Market Place, Pocklington, York), in which the heads of the Barley were out of their sheaths, but the black channels showing where the *Chlorops* grubs had fed were remarkably observable. These may always be looked on as a sign of this attack.

On Aug. 8th Mr. Geo. Cook forwarded specimens of *Chlorops*-injury to Barley from Kitwick Wood, Ampthill, with the remark that this attack appeared more destructive than that of the Hessian Fly. He noted:—"You will observe that it appears to eat away part of the stalk near to the ear, and in several cases I noticed it had eaten the unripe kernels of the grain itself. It appears to attack the later-sown crops the most, as I do not discover it in the first-sown Barley of my friend or my own. The crop in the usual four-course rotation; the previous crop, Swedes eaten off with sheep, and the crop before Swedes was Wheat."

On Aug. 28th the following note of *Chlorops* attack and estimate of damage was sent me by Mr. Riley from Hessle, near Hull:—

"I sent you yesterday some stalks of Barley reported to me by two or three farmers as badly infested with "Hessian Fly." I therefore drove over on Friday to see the field, and found that it was not 'Hessian Fly,' as it had begun *from the ear and worked down to the first joint*, and found it had done *ten times* the amount of damage done by the 'Hessian Fly.' I and two other very practical farmers thought the crop was damaged *fully one-third*. I have not yet seen a field damaged more than *one bushel* an acre, simply because the attack came *late*. The

Barley (specimens sent) was sown *late*; the previous crop *Turnip*, and *very good*; one or two other late pieces of Barley are so infested."

On Aug. 5th specimens of a remarkably bad attack of *Chlorops teniopus* were forwarded to me from Barley at Ropley, near Alresford, Hants, by Mr. J. W. Snelling, Winchester. The ear in some instances was hardly freed from the sheath, and the stem above the highest knot was only from about $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long. The ears were stunted and injured, and the direct injury from the maggot gnawing usually affecting the lowest part of the ear, or as much as halfway up.

From the above returns it appears that the attack was present in Hampshire and Kent; in Essex, Herts, Beds., Cambridgeshire, Leicestershire, and on the border of Leicester and Warwickshire; also in Northamptonshire and in Yorkshire; and it was also present in Cheshire. Only one note was sent me of presence in Scotland, and this was in Ayrshire.

The specimens sent me showed various degrees of injury; as the growth being stopped at six to nine inches high; the ear still muffled in the sheath; the uppermost joint of the stem stunted to about two inches in length, the base of the ear and sometimes half of the lower part being destroyed by the maggot; and (constantly) the gnawed and blackened channel where the *Chlorops* maggot had eaten its way down from the ear to the uppermost knot was clearly noticeable.

Looking at the remarks as to amount of injury sent in by observers, the highest estimates were of more than half stopped in growth, and of one-third of the attacked Barley; also it was noted as doing great damage to Barley,—materially lessening the chance of a crop,—and as appearing more destructive than Hessian Fly.

This is a kind of attack in which it would be very useful if the sufferers from it would give particulars of the nature of the land on which it occurred, most especially whether it was found in patches in the fields, and whether these patches, large or small, were lower-lying than the rest of the land. Where I have most observed this attack in former years such has been the case. I have seen it on an acre or more forming a kind of hollow; also near Isleworth in a low-lying portion of a field which had not been properly drained when thrown into cultivation after the surface-layer of brick-earth had been removed. It is also said to occur along water-furrows, and in the very bad case of *Chlorops* attack which occurred last year at High Legh, Cheshire, the part of the field from which specimens were sent me was reported as low-lying and damp. This attack deserves special mention.

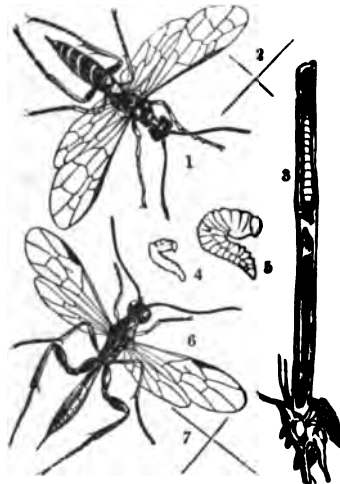
On Oct. 8th I was favoured by a communication from Mr. B. Kendrick, 98, Golborne Street, Warrington (Hon. Curator for Entomology, &c., of the Warrington Museum), relatively to severe damage to Barley at High Legh, Cheshire, which had been erroneously attributed to Hessian Fly.

Mr. Kendrick visited the spot, and forwarded me samples of the Barley which were infested, not by Hessian Fly but by *Chlorops*, and badly injured; and accompanying these he sent a report that he could not find any stems bent from insect injury, but found stunted Barley-ears, which had not been able to emerge from their sheaths; and on referring Mr. Kendrick to the description of *Chlorops* attack and the figure given at the head of this paper, he stated there could be no doubt of the identity.

This account and identification is of importance, as temporarily much alarm was raised regarding the supposed Hessian Fly attack; but, further, it is of interest relatively (as I noticed just above) to the low and damp situation of the examined Barley. This was stated to be a "good-sized patch in the lowest and apparently rather swampy part of the field"; also the ground "was much overgrown with *Persicarias*," a weed which it is unnecessary to say thrives in moist places.

If this attack especially affects damp spots, or spots which have been wet and then surface-baked, one method of prevention would be obvious; but, as in all the many years in which I have known it this attack has never before been serious, I attribute its severity last year to the unusual heat and drought, and should not conjecture that a recurrence was to be expected.

Corn Sawfly. *Cephus pygmaeus*, Curtis.



CEPHUS PYGMEUS.

1, 2, Sawfly, magnified, with nat. size; 3, stem containing maggot; 4, 5, maggot, mag. and nat. size; 6, 7, parasite fly, *Pachymerus calcitrator*, mag., with nat. size.

The presence of Corn Sawfly, like that of *Chlorops* was much more observed than is usually the case in England last year, and the notes

I received showed it to be at least scattered over a wide area. Note were sent with specimens accompanying, showing it to be present in one or more localities in Essex; near Long Melford, Suffolk; in Cambs., Beds., Hunts, Lincolnshire, and Northamptonshire; also in Berks, Oxfordshire, near Reading, and in Hampshire; but I had no observations sent of it being noticed in the North of England, or in Scotland.

It will be observed that these localities correspond very much with those of *Chlorops* and with the districts where the Hessian Fly was most prevalent in England, but whether this circumstance arises from the attack chiefly existing in this area, or from attention being more drawn to the subject of corn-stalk pests in these localities, I am unable to say.

The method of life of the Sawfly grub is to feed *within* the corn-stem, clearing the inside of the knots in its passage, and about harvest-time it comes down to ground level, where it gnaws a ring so neatly and cleanly round inside the stem that the straw readily falls with its own weight, or from slight pressure of the wind, the severed stalk showing almost as smooth a fracture as if it had been separated by a knife. As, both in this case and in bad injury from Hessian Fly, the straw falls, the two attacks are very liable to be confused in mere casual examination; but when looked at with care it will be readily seen that in this Sawfly attack the straw is cut through (fairly separated) at ground level, and in Hessian Fly injury the stalk is *not* cut through, but elbows sharply down commonly at the second joint from the ground, and consequently on the weaknesses caused by the maggots *sucking outside* the stem at the spot where they turn to the flat flax-seed-like chrysalids.

The Corn Sawfly has long been known in this country as a crop-pest, and also on the Continent of Europe, but, as far as I have been able to learn by investigation or enquiry, it is not a crop-pest of America; and as I have pointed out elsewhere, this is not one of the attacks which can be conveyed in grain, chaff, or straw. The maggot itself cuts the corn-stalk below where the cutters of the reaper separate the stems and it remains, not in the upper part, which is carried away, but down in the stump which remains in the ground. There it spins itself a thin cocoon for its winter protection, and there it remains until the early summer of the following year, when the four-winged black-and-yellow fly (see fig. p. 59) comes out of the chrysalis to which the maggot had turned in the straw.

As the maggot remains down the stump left in the ground, it is not liable to be removed in the reaped straw, and any method which may be preferred of destroying the infested stubble will get rid of danger of recurrence of attack from that of the preceding year.

Ploughing would not do this securely unless the stubble was thoroughly well buried down; if only partly buried the maggots

would probably be no way injured. If it could be completely buried down and left there this would answer; but I believe the most sure plan is after harrowing, &c., to collect the stubble in heaps and burn it.

The first *signs* of the coming of the attack of the Corn Sawfly which proved so noticeable last year were reported to me by Mr. Thomas P. Brand, of Brook Hall, Foxearth, Long Melford, on the 28th of June; this is worth remarking, for it is very seldom indeed that it happens that in crop-attacks of this kind we have information of the appearance of the insect, be it fly or otherwise, which will give rise to the mischief, before the crop has shown that the havoc has been established.

Mr. Brand wrote me on June 28th :—

"I have sent you two flies which I caught off my Wheat last evening, and saw a great quantity more of them."

Of these specimens one was still alive, and was excellently characteristic of the appearance of this kind of Corn Sawfly, as described at length further on.

On the 20th of July Mr. Whitehead informed me that he had a lot of straw (Barley) sent from Huntingdon, with *Cephus pygmaeus* maggots in every stem.

July 26th. Mr. W. Rance wrote me from Taplow, Maidenhead, that he had six acres of spring Wheat, which had a very bad appearance, and on examination he found it affected by a grub in the stem close down to the root,—specimens accompanying showed this to be the Corn Sawfly maggot.

On the 28th of July Mr. William Hall forwarded me a parcel of Wheat roots and stems, containing a grub close to the ground, from Redbourne, Kirton Lindsey (Lincolnshire), with the observation that he had been much struck by a quantity of his Wheat appearing as if it was what is called storm-broken, and on examination he found in all cases that there was a grub, either close to the ground or a little way up the stem.

The samples forwarded proved to be remarkably characteristic specimens of Corn Sawfly attack; the Sawfly maggot was down quite at the bottom within the stem, and the crisp, clean breaking off of the stem at the ring which the maggot had bitten within was very noticeable.

On the 1st of Aug. Mr. W. Hall further mentioned that the Sawfly attack had quite damaged the yield of the Wheat in that parish (Kirton Lindsey) from a sack to a quarter of an acre.

On July 30th Messrs. Sutton and Son, of Reading, consulted me regarding attack to a large quantity of Wheat on a farm in the neighbourhood of Reading, which on examination of specimens proved also to be injured by *Cephus pygmaeus*; and on the same day Messrs. Oakshott and Millard likewise desired an opinion on "stems of Wheat

attacked by some minute maggot inside the pipe, which causes the ear to go off prematurely"; this attack on examination proved to be that of the above-named pest.

Somewhat later on Messrs. Oakshott remarked, of this corn-pest, that it appeared to them "from what we have seen of further specimens brought us to-day, to be likely to be even more serious than the Hessian Fly.

Some of the above information was given by Mr. E. Whitfield, of Goring Heath, near Reading, who after an interview with me, further reported on the 9th of August:—"Since I saw you last Thursday I have examined several more pieces of corn in my neighbourhood and find the same pest in them all more or less (excepting in Oats). I yesterday searched through a field of Barley and Oats mixed; I could find the maggot in the Barley but not in the Oats, so that I feel satisfied it does not attack Oats. One thing I have remarked particularly in my Barley, that is, on the parts of the field where the best Turnips were and more corn fed by sheep, there is more ravage by the fly, although it was all drilled the same day and treated in the same way exactly. Do you think the very long dry hot season is the cause of the extensive ravages of this fly? This part of Oxon lies high, and the land is as a rule light poor soil, and feels drought severely. We have had only two showers since the 8rd of June."

Mr. Whitfield's report regarding previous treatment of the land where the Wheat was injured, showed similar amount of attack after Clover; and also "where the Clover being thin had been ploughed up after the hay was gathered and Mustard sown. This, together with the aftermath, was fed off by sheep. A good fair coating of manure was applied and the Wheat sown in October"; and on another Wheat-field on a better soil, after a summer fallow, and a fair coating of manure, and seed sown in November, the attack was about the same in amount.

In the case of another field of Barley which was after Wheat (the latter a very bad crop), Mr. Whitfield observed that he did not notice that the fly was in the Wheat in the preceding year, but the amount of attack in the year's Barley was about the same as in the other fields. All the fields were quite separate from each other on different parts of the farm.

With regard to amount of damage, it was mentioned by Mr. Whitfield:—"Some of the ears appear to be full and not much the worse, whilst others have only thin corns in them; the straw being laid down, much damage arises from the machine cutting the ears off; the straw also would be rendered unsaleable for plaiting purposes, being filled as it is with dust."

The prevalence of this crop-pest near Birchmoor, Woburn, Beds., was reported on Aug. 8rd by Mr. Edward Blundell, who remarked

(comparing the relative amount of this and of Hessian Fly):—"So far as I have at present seen *Cephus pygmaeus* is much the most busy with us, for I can find it in great abundance in nearly every Wheat-field in the district.

On August 6th I had examples of attack of the same corn-pest sent me by Mr. R. Lesson Martin from Helpston Village, Market Deeping, out a crop of Wheat then being cut; and also on Aug. 6th, a specimen of *Cephus pygmaeus* attack with the maggot in the straw, was sent me by Mr. F. Scorer, from Swinhope, Great Grimsby, accompanying samples of Hessian Fly attack.

On the 9th of August specimens of straw were sent by Mr. Stephenson, from Burwell, near Cambridge, showing the straw partly filled with the sawdust-like excrementitious matter consequent on the Sawfly maggot feeding within the stalk; and on the 15th Messrs. J. Robinson and Son, of Northall, Kettering, forwarded samples of the same attack, with the observation that neighbours had applied to them in great trouble on this account.

The following notes from Mr. D. D. Gibb, of Thorn's Farm, Lymington, gives a somewhat more detailed account of the appearance of the attack. On the 17th of August he noted that at harvest-time he had found in the Wheat what he believed to be the Corn Sawfly (*Cephus pygmaeus*), "had been busy at work; the larva had cut the straw at ground-level, the stalks falling down presented a very pinched appearance,—in some cases worthless. To-day, on inspecting some late-sown Barley, I found the Sawfly had again showed itself there in great numbers."

Mr. E. M. Edwards, writing on the 24th of August, from the Precincts, Peterborough, forwarded straws showing the depredations of the Sawfly maggots, and in some cases the insects then present, from a portion of a Wheatfield in the neighbourhood, which was much destroyed by the grubs.

On Aug. 22nd specimens of Sawfly attack were sent me from near Spalding, Lincolnshire; and on Sept. 5th Mr. J. A. Smith, of Akenham, Ipswich, wrote that in looking *ineffectually* for the Hessian Fly on his own farm, he had for the first time become aware of the great damage inflicted on the crops by Corn Sawfly.

There does not appear to be any reason to fear recurrence of attack from infestations of one year keeping up supply to the next, in places where the maggot has been destroyed in the stubble, as mentioned at p. 60; but as attention has been directed to this subject, it would be of serviceable interest to know whether in the coming season the corn-pest is again very noticeable, and also to have estimates of the damage caused by it. I should be greatly obliged if my correspondents would give me details regarding this attack, if it should occur, or also that of *Chlorops*, which is previously noticed.

**"Tulip-root" Disease from Eelworm, *Tylenchus devastatrix*,
Kuhn.**



TULIP-ROOTED OAT PLANT.

The disease known as "Tulip-root" in Oats takes its name from the swollen appearance of the base of the stem, which bears some resemblance to a Tulip-bulb, though still more to a "duck-necked" Onion. This swelled stem is usually surrounded by a number of small doubled-up shoots, pale in colour, and bent to and fro instead of being properly extended. The above figure shows the appearance of an attacked plant as it is often seen; the disease is also known as "Segging," or "Sedging," from the Sedge-like appearance often assumed by the leaves. From the healthy growth of the plant being checked there is necessarily much loss both in straw and grain.

This disease has been much noticed of late years, especially in Scotland; and on investigation in 1886, I found Eelworms present in the bulb-like base of the stems, as well as in the spongy curled shoots; and from the resemblance of the diseased Oat-plants to the diseased appearance which is assumed by Rye when attacked by the Eelworm known by the name of *Tylenchus devastatrix*, it appeared likely that this Eelworm was also the cause of our attack, and on special examination being made by Dr. J. G. de Man and Dr. Ritzema Bos (already referred to in this report relatively to their studies of this subject) such proved to be the case.

During the spring of 1887 I was favoured by Dr. Ritzema Bos (for the sake of parallel examination) with specimens of young Rye-plants, of about three to five inches high, suffering from the "stem-sickness," as this attack, answering to our "Tulip-root" in Oats caused by the Eelworm above mentioned, is called in Germany. These plants showed precisely the same nature of deformed growth as our own Tulip-rooted Oats; the lower part of the stem was similarly

swollen, and round the base (similarly also to our Eelworm-diseased Oat-plants) there were sometimes short, pale, abortive shoots, wrinkled or folded to or fro on themselves. Within the swollen bulb the Nematodes or Eelworms were very plainly to be seen, and with a 1-9th object-glass I could easily distinguish the smooth spear and its lobed base.*

These Eelworms, that is the kind known as *Tylenchus devastatrix* (which is much smaller than the species figured), infest many kinds of plants, but as far as we know at present do not infest Peas or Beans; and it is of very practical importance relatively, to change of crop on infested land, to know what is safe from its attacks. The following observations refer to examination of Beans and of Wheat.

In 1886, as there were doubts as to Beans being infested, I examined specimens, but could not find an infestation present.

In 1887, Mr. R. Drennan, writing from Goatfoot Farm, Galston, Ayrshire, forwarded me, on the 18th of May, samples of Beans and Oat-plants, from a locality which had suffered seriously with Tulip-root "for a number of years"; he also forwarded me a sample of Wheat from other land which had been badly attacked by Tulip-root when it had been cropped with Oats.

On examination, Dr. R. Bos found *Tylenchus* in the Oats, but *none* in the Beans, and *none* in the Wheat; and relatively to possible presence of this pest in Wheat, he mentioned that during four years' experiments with Wheat sown by him on land infested by *T. devastatrix* from Rye (the same which infests our Tulip-rooted Oats), the Wheat "never became diseased in a clear and pronounced manner."

* The accompanying figure of the kind of *Tylenchus*, the *T. tritici*, which causes ear-cockle galls in Wheat, is added to give a general idea of the shape of the *T. devastatrix* which causes Tulip-root in Oats.



TYLENCHUS TRITICI.

Wormlets escaping from eggs; section of Cockle-gall with wormlets within (after Bauer's figs.), *T. tritici*, all much magnified. Spikelet of Wheat with Cockle-galls, magnified. Nat. length of wormlet one-seventh to one-fourth inch.

It had been stated by previous observers of the subject, that this special kind of Eelworm never lives in Wheat; but Dr. R. Bos found it was present in the Wheat above mentioned, though never in large numbers; and he considered that *Tylenchus devastatrix* CAN live in Wheat-plants, but *does not* do so, *unless* there are no other plants on the land which it likes better."

The first specimens of Tulip-rooted Oats which I received in 1887 were sent me on the 80th of May, by Mr. Thos. Picken, of the Field-house Farm, near Brentwood, and, from the notes sent accompanying, it appears that the portion of the Oat-crop from which these samples were sent (*which was not dunged*) was the only part of his Oats which was affected.

Mr. Picken wrote :—" We commenced sowing Oats on the 29th of March (seed from the Lincolnshire Fens); the *first* day's sowing was after a heavy crop of Mangold, which are doing exceptionally well. *Second* day's sowing after a poor crop of Tares on foul land, which also looks well. *Third* day's sowing after clean fallow, some of which was dunged and looks well, and some (*about half*) *has gone off in the way of the enclosed.*" These Oats were thoroughly characteristic specimens of Tulip-root. Some sent a few days later were still more diseased, being little more than small masses of crinkled-up yellow shoots; the greatest height of the healthy leaves on the others only ranged up to about three or four inches.

On examination of these plants Dr. de Man favoured me with the information that he had found in the interior of the basal part of the stem *a large quantity of living* specimens of *T. devastatrix*, and a few days later Dr. de Man added that he had examined more of the plants, and had observed in all of them large quantities of living specimens of *T. devastatrix*.

Dr. Ritzema Bos also considered the above to be very characteristic specimens of the peculiar diseased growth under consideration, and on examination he found in them "a large number of *Tylenchus devastatrix* males and females, larvæ and eggs."

Specimens of Oats in a very early stage of attack were sent me on the 8th of June, by Mr. Richard Brown, from Hill House, Kirk Newton, Midlothian. The plants were somewhat swollen at the base, but as yet only one plant had advanced to having the characteristic small pale crinkled shoots; on opening them I found Eelworm of various sizes within, and the egg was present also.

Mr. Richard Brown mentioned that the specimens had been pulled "at the earliest moment we have been able to discover any appearance of the disease. These grew on a field worked on the four-course shift, which was Hay last year, and before ploughing the lea got a good

application of gas-lime. The land is in fair condition, but it is also liable to 'Finger-and-Toe.'"

On the 9th of June specimens of badly Tulip-rooted Oats, in which I found Eelworms, were sent me from Hogmore Farm, Wrotham, by Mr. W. J. Goodwin, with a note that they were from a twenty-acre field, and that he "did not expect to grow more than two or three quarters per acre"; also that "the same disease had been known before in the same field, but not such a bad attack"; and that he heard many fields in the neighbourhood were struck in the same way.

Specimens of Tulip-rooted Oats having the bulb swollen, but much of the deformed side-growth of little shoots then developed, were sent me on the 20th of June, from Peterhead, Aberdeenshire, by Mr. J. C. Greig. The Eelworms were clearly noticeable within. Mr. Greig observed first, relatively to the various names by which this attack is known:—"It goes here by the name of 'Sedging' (locally 'Segging'), from the fact of it growing only a bunch of Sedge-like leaves but never forms a grain, and by harvest, when the leaves are down, where badly "segged" the crop is almost *nil*." [This of course refers to the worst form of attack.—ED.] "So far as I am aware it seems to be confined within a small radius here, and always on strong land."

Somewhat later, that is on the 6th of July, Mr. Greig wrote me further regarding the Tulip-root attack or "segging" of Oats, that it usually showed itself there in a special part of the rotation. He remarked, "The land here (at least on all strong soils liable to ("segging")), is worked on what is called a seven-course shift, that is, two white crops, Turnips, white crop again, and three grasses. It ("segging") usually shows itself on second year's corn and after Turnips; a crop of Barley after Turnips seems to stop it for that time. This year, however, it has shown itself mostly on corn after lea." . . .

The following observation shows recurrence of Tulip-root attack to Oats sown on land infested in the previous year:—

On the 12th of July I received a sample of Tulip-rooted Oats infested by Eelworms, with their eggs also noticeable, from Mr. Holland, the Consulting Botanist of the Royal Manchester, Liverpool, and North Lancashire Agricultural Society (Frodsham, Warrington). These Oats were grown on the Experimental Ground of the Society at Saltney, and Mr. Holland remarked, "Last year we had Oats on the same plot, and they were almost entirely destroyed by the disease, and we supposed it to be caused, or at any rate aggravated, by the very wet season. We sowed Oats again to see if it would again appear, which it has done, although the Oats are a different variety (and therefore the seed has nothing to do with it), and though this season is as dry as last season was wet, showing that weather does not affect it."

On the 19th of July Mr. Robert Holland further mentioned that, though he had grown Oats for thirty years at least, and been in the habit of observing, yet he could not positively say he had seen Tulip-root until the previous year. He further remarked, "The plants I sent you were grown in Flintshire, though only four miles from Chester, but the disease was also observed in Cheshire, at Mr. John Lea's of Stapleford Hall, not far from Tarporley. . . . The field from which my specimens were obtained was in Wheat in 1885. The Wheat was succeeded by Oats in 1886, and, as I mentioned, they were destroyed by the disease. They were sown on the same ground again this year, partly with a view of ascertaining whether they would again be affected. They are so, though hardly to so great an extent. That the Oats, this year, were attacked by the parasites which remained in the ground, or in the stubble, from last year's crop, one can scarcely doubt; but then, how did last year's Oats become diseased? I think, but I am not sure, that the Wheat was grown on Clover ley; but we are not subject to Clover-sickness in this part of the country."

In this case (as in many others) we cannot tell for sure how the attack came, but still Mr. Holland's note shows that the land has been four years under plants subject to Eelworm, so that a change to a crop not liable to infestation is now important.

On August 80th I was favoured with the following report by Mr. Robert Dundas, of Arniston, Gorebridge, Mid Lothian, N.B. In the previous year Mr. Dundas had contributed some notes of much interest on the subject, together with a map of fields attacked at Arniston Mains, which I have given at page 42 of my 10th Report, and the information now added is very serviceable, both as showing that attack is not necessarily continued from one year to the next; consequently it would help very much in badly infested districts, if we could have notes of treatment which has been used in these cases where attack has *not* continued, and also in cases where attack *has* continued.

Mr. Dundas mentioned, . . . "In 1885 a field of Oats was badly affected with the disease, but during the past two years nothing has been observed wrong with the pasture. In 1886 another field of Oats was badly affected by the disease, one spot in particular, of about four acres in extent, being quite destroyed. This year, on that place, no sign appears of anything being amiss with the Clover, which is a good crop.

"In 1887 a third field of Oats has been affected by Tulip-root, from which the enclosed bundle has been taken. But instead of great spots over several acres this year, the spots in the field affected are few in number, and only of a few yards in extent. In fact, if I had not

been on the look-out, this year's spots would have been scarcely noticed, or, if noticed, ascribed to rabbits."

At present very little information has been sent in (excepting one note in the preceding observation) as to effect of farm manure in pushing the plant past attack, but the following observations of Mr. Elder, of The Holmes, Uphall, Linlithgowshire, point to the disease being worst on gravelly elevations, and also mention the good effects of sulphate of potash, and the *non-effect* of nitrate of soda in the case of a field experimented on and described in the observations as field "No. 2."

The experiments were made in 1886, and alluded to at p. 40 of my Report for that year, and on the 30th of March, 1887, I was favoured by Mr. John Elder with a more detailed account of his experiment.

Mr. Elder remarked, "My farm is mostly free alluvial soil, with some gentle knolls of sand or gravel. These knolls were worst affected with Tulip-root, the more retentive soil immediately surrounding them being entirely free and a very heavy crop. A portion of one field which was heavy loamy soil, was more or less affected, but in this case the drainage was bad, and the land soured.

"What I have written refers to Oat crop after Potatoes and Turnips, manured with horse and cow dung, and receiving no special treatment."

So far the notes show occurrence of the disease where there was some special state of ground which would influence the growth of the plant, as the soured land or the raised sandy knolls; the following observations refer to action of the chemical dressings. Mr. Elder continued—

"Other two fields were Oats after Hay, after Barley, after Turnips, Beans, and Potatoes. No. 1 received when sown (in addition to an allowance of bones), about 28 lbs. of sulphate of potash, and the same of sulphate of ammonia. A good sound crop was the result, no Tulip-root being observable *except on a gravelly knoll*, and even then to a small extent."

The second of the fields was reported at length as follows:—

"No. 2 received superphosphate and sulphate of ammonia, but no sulphate of potash when sown, except the head-rigs, which received at the rate of three-quarter cwt. per acre in addition to superphosphate and ammonia, when I sowed Vetches and Oats in equal proportions. The effect of the potash was most extraordinary, and where I ran short before coming to the end of the field there the effect ceased,—what received the potash grew on most luxuriantly, while the whole of the field (with that exception) threatened to be a complete failure.

"I then gave 1 cwt. of nitrate of soda per acre (to field No. 2), . . . but this, after a fortnight of growing weather, was making no improvement. I then procured sulphate of potash and applied half

cwt. or so per acre; a nice shower washed it in at once, and a fortnight after no one would have known it to be the same field, and I harvested a very heavy crop from it."

As far as I can gather from the observations of 1886 and '87, and also from Continental practice, a good growth on properly cultivated land, neither too dry on knolls nor soured by being undrained, and also a liberal supply of rich manure, help greatly to bring the crop through or prevent attack. But where stock have been fed on straw or Clover which has suffered from Eelworm attack, it is absolutely necessary that the manure made from infested fodder should not be used on any field where crops are to be grown which are liable to infestation, for the following reason:—This kind of Eelworm can be passed through the animal along with the digesting food without being harmed, and therefore is just as likely as not to be carted out within the manure from the yards to which it was brought in within the straw. For this reason superphosphate or guano have been recommended in preference to manure which may have been made from infested fodder, or which *may have had infested plants thrown to rot on the heap.*

This point is well worth attention, as it very probably accounts for the patches, large or small, of infestation in fields where otherwise all is free. In a valuable paper of researches on *Tylenchus devastatrix*,* published by Dr. Ritzema Bos on July 1st, 1887, a list is given of various wild and cultivated plants which are known to be liable to infestation of this Eelworm, and the list throws great light on the method by which infestation may arise. Amongst corn and grasses Oats and Rye are noticed as infested, and Wheat as having been found diseased in the same manner as Rye but much less severely. The Sweet Vernal Grass, Annual Poa, and Meadow Soft-grass are mentioned as liable to infestation, and the pest has been found to occur in small quantity in the Common Buttercup, the Daisy, and the Common Plantain known as Ribwort: likewise in Shepherd's Cress, Sow Thistle, also common weeds; and the wild and the cultivated Teazel are both subject to attack. Buckwheat is noted as liable to severe attack, and the Common Onion is recorded in the list as suffering annually in Zeeland and South Holland from severe attack of this *Tylenchus devastatrix*. Other weeds and cultivated plants are mentioned in the list, but at present, in this country, as far as we have worked out, Clover† and Oats are the only plants which suffer severely.

Without going into further considerations, it has been clearly shown that where there has been an infested crop one year, it is

* Untersuchungen über *Tylenchus devastatrix*, Kuhn, von Dr. J. Ritzema Bos.—Biologisches Centralblatt, vii. Band No. 9, 1 July, 1887.

† See 'Clover-sickness,' pp. 1—9 of this Report.

almost certain, or at least exceedingly likely, that there will be an infested crop in the following year, if anything is put in liable to attack; therefore it would be eminently desirable *not* to put in such crops immediately.

Barley has been experimented on by Dr. R. Bos and found *not* to take infestation, and in the notes of Mr. Greig, of Peterhead, at p. 67 it is remarked of this attack that a "crop of Barley after Turnips appears to stop it for that time." Peas and Beans appear to be safe, and Wheat just to have a possibility of taking it, but to suffer very slightly. Where infestation is established in the field, excessively deep ploughing is a remedy, for the wormlets cannot make their way up again; but even moderate ploughing, if the *surface slice* is well turned down, does much good, as it is mainly at the surface that the wormlets which have left the plants lie, and a good dressing of caustic lime or gas-lime applied before ploughing would probably also do good. In favourable circumstances the wormlets may live on for years, supporting themselves on various kinds of weed-food until a suitable crop recurs. But by the above-mentioned measures they may be so buried or starved, or poisoned, that what may survive will be too few to do much mischief.

This treatment of the land; a safe crop immediately succeeding an infested crop; care *not* to bring back infestation to the fields; and all points of good cultivation calculated to push on a healthy growth, are the best measures that can be used to counteract Eelworm disease.

Common Granary Weevil, *Calandra granaria*, Lin.; and Rice, or Spotted Granary Weevil, *C. oryzae*, Lin.



CALANDRA GRANARIA and C. ORYZÆ.

6, 7. Granary Weevil; 2, 8, chrysalis, nat. size and mag.; 8, 9, Spotted or Rice Weevil, nat. size and mag., likewise infested grains, mag.

The Granary Weevil can perhaps hardly be said to take a place among crop-pests, as the growing corn in the fields is precisely the

place where it is *not* to be found ; but as when the corn is stored this small weevil is apt to be one of the worst pests of our granaries, it requires some mention.

These small beetles are of the shape figured above at p. 71, rather more than the eighth of an inch in length, and furnished with a long snout, and they may readily be distinguished from the kind figured with them by being of a pitchy brown colour. The Rice Weevil as it is called (but which might be more conveniently known as the Spotted Granary Weevil) figured page 71, is usually distinguished by having four paler spots above. This kind is excessively injurious to imported grain of various kinds, but it does not as far as we know increase here, on account of the weather not being warm enough for its multiplication to any observable extent.

Our regular Granary Weevil, so to distinguish the British *unspotted* kind, feeds in maggot-state in most kinds of corn, notably in Wheat and Barley, especially doing harm in malt, and also attacks Rye and Maize. The female beetle makes a hole with her proboscis or snout in a corn-grain, and lays an egg therein—one egg in each grain which she attacks. The maggot, which soon hatches, feeds on the flour of the grain and turns within it to chrysalis state, from which the weevil soon comes out. Increase is very rapid ; it is considered “ that in the course of a week one female can lay up to as many as 150 eggs,”* and consequent destruction of grain is very great. To gain an idea of their powers I have placed a small heap of corn in a loft near an infested granary, and very shortly the weevils found it out and (though they are wingless) crept to the heap, and in a short time riddled a large proportion of it. It is supposed that the beetles feed on the flour of the grain to some extent, as well as the maggots, which often nearly clear the inside out, and amongst a number of this *Calandra granaria* which I have by me, in order to watch their habits, I find the beetles collected in parties in the outside skin of Maize grains. This points strongly to the *Calandra* feeding in beetle state, because one grain of Wheat or Rye is enough or more than enough for the nourishment of the one maggot which lives in it ; therefore where the much larger Maize-grains are reduced to mere outer films, it appears there must have been the beetles as well as the one maggot at work to clear it. This matter is of some importance, in consideration of damage, as it explains why these beetles may be found in flour, which is not, as far as we know, used by them for egg deposit, or for rearing the young.

In the course of last October I received samples of these weevils, with which some sacks of flour sent to a large public institution had

* ‘ Insekten kunde,’ by Dr. E. L. Taschenberg, pt. ii. p. 173.

been found perfectly infested,* and in all probability these weevils had made their way into the flour from infested corn or granaries or stores, in which places they harbour in all available chinks.

In September I received a box with samples of these same Granary Weevils, of which the sender, writing from a farm in the North of England, remarked that they "are a great trouble to me in my granary. They attack Wheat while it is in the garner or in bags. . . . They seem to multiply very quickly and eat all the inside of the grain."

On the 1st of November I received a note from a correspondent in the London district, mentioning that his "Barley and malt were swarming with weevil."

A few days later he further noted (with specimens of the beetle sent accompanying)—"There was a large quantity of malt of last year's make which was kept over, as is generally done, in a bin, and when it was screened we found it to be simply swarming with weevil. This is a very common occurrence, as all know who have to do with malt. I have reason to suspect that they were introduced into my house by some foreign Barley, as grain-ships often swarm with them." There is no doubt that grain-ships are infested by the *Calandra* or Granary Weevil, as well as our own home stores, and in the note† is appended a method of sifting out the weevils and dirt, which might with great advantage be much more generally made use of, especially if the results of the operation were forthwith destroyed.

There was formerly an opinion that this weevil left the corn heaps in winter. This, however, does not appear to be the case where the

* I do not give the names of localities of my correspondents on Granary Weevil, as, although this attack exists all over the country and has been known as injurious here for at least more than fifty years, names of special localities of presence might be unpleasant, precisely to those who are doing most to get rid of it.

† "When the cargo is very badly affected—when the whole bulk seems alive as I have myself seen them on very hot summer days—it is a common practice for merchants to spout it, *i. e.*, to shoot the grain down a spouted trough, in which at the angle is a wire sieve with meshes large enough to let the weevils pass through, but not the corn, which runs into the granary or into sacks, as the case may be. By such means the quantity of weevils and dust sifted out is enormous; and this appliance is geneally so situated at the wharves that the beetles are deposited near the edge of the wharf or even in the river-bed, and if not naturally washed away at high tide are swept into the water, their destruction being thus easily accomplished. The great heat generated in a bulk of weevily corn is caused by the dust arising from the borings and frass of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot, when they are especially lively on the outside."—From 'Granary Weevils, *S. granaria* and *S. oryza*,' by Edward A. Fitch, the 'Entomologist' for Feb. 1879, pp. 42—43.

heaps are large enough to form a good shelter. One of my correspondents states, "I find that the weevils infest the Barley-malt, and do not come out unless disturbed. We have lately been doing this, and as a consequence find them in all the available chinks and crannies. . . . In my case the heap was amply large enough to afford them shelter and protection from chills, consequently until disturbed they were not found at any distance from the malt-bins. But even if they do not leave the corn-heaps as a regular matter, they are to be found in chinks and crevices, and between planks and wood-work all about stores where corn is kept, and it is from such places that they come out to infest new supplies."

For requisite treatment I believe no better advice can be given than that conveyed in some of the concluding words of the paper by Mr. E. A. Fitch, of Maldon, Essex, which is previously quoted from. From the careful study Mr. Fitch bestowed on the subject, as well as his personal observation of the matter in his own stores, his digest of the measures which can be serviceably used is of much value :—

"Cleanliness alone will do the required work, and this requires to be thorough to cope with such a crevice- and cranny-loving hybernating insect as the *Calandra*. Frequent lime-washing and scrubbing (with soft soap) of granaries, the plastering of all uneven wall-surfaces, the asphaltting or concreting of all unlevel floors, the free use of the dressing-machine or blower, and frequent sifting or turning over of the grain are the only likely remedies against weevil attack. It is also necessary to guard against mixing sound Wheat with any containing weevil, except for immediate grinding; also to see to the destruction of all rubbish and tail-corn in which it is possible for beetles to live and breed.*"

The love of warmth of the weevils may be turned to account in the German method of trapping them. This is to lay a sheepskin, wool downwards, by the corn heaps; here the beetles collect, and are so entangled that with care they may be carried away and beaten out of the skins and destroyed.† As warmth is requisite to their breeding freely, everything which will keep down the temperature of the infested corn is useful, more particularly as, where they are in great numbers, considerable heat is engendered (as is well known in the case of infested corn-ships) by the results of their accumulations of frass or workings. This is so well known that I have received enquiries from shippers as to whether "the heat generated the beetles." This is certainly not the case. It is the beetles and maggots which generate the heat; but at the same time the heat is so favourable to their reproduction that under such circumstances they

* 'Granary Weevils,' by E. A. Fitch, the 'Entomologist,' Feb. 1879, p. 50.

† 'Insekten kunde,' by Dr. E. L. Taschenberg, pt. ii. p. 174.

multiply the quickest. In Germany "air-drains" are used to cool the heaps, and this is considered the surest way to prevent damage. Drain-pipes are laid in various directions through the heaps, and the temperature of the heaps and the surrounding atmosphere is thus considerably lowered.

Turning or stirring the heaps, which is strongly advised, answers the same purpose; and in the following communication, a member of a firm largely interested in imported grain, especially draws attention in the passages which I have marked in italics to the importance of turning the Wheat in *frosty weather*, and of keeping up a *good draught*.

"We unfortunately have had a great deal of experience of the mischief done by these animals. They breed very rapidly, we find, in warm weather, particularly in Wheat from Russia; but can *usually be got rid of by turning the Wheat in frosty weather, if the warehouse is in an open situation with a good through draught*. Sometimes during a mild winter it is impossible to get rid of them. This was the case in the winter of 1884-85; we lost between £1000 and £2000 on a single cargo of Russian Wheat from this cause. Some seasons, such as the summer of 1886, they seem to do but little harm.

"As a rule, weevils are imported every year in Russian and Indian Wheats, and do more or less harm in the autumn, but are got rid of in the first severe frost. Occasionally weevils imported in distant cargoes do not seem to breed at all. We had an Australian cargo in bags in 1885 in which there were a good many weevils in the sweepings, but these never seemed to breed or increase."

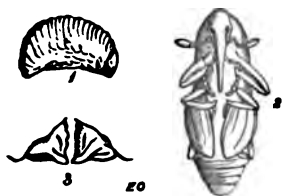
These would very likely be the *Calandra oryza*, which, though very destructive in imported corn is considered not to breed—or at least not to any extent—in this country, consequently on the temperature not being warm enough for it.

In regard to this matter I tried some experiments, extending from the beginning of September in 1877 to the latter part of October in the following year, and I give an abstract of the observations, as I am not aware of other notes regarding propagation of this kind of Granary Weevil in England having been published.

Life-history of Calandra (Sitophilus) oryza, commonly known as Rice Weevil, although found in several kinds of grain.

The observations were made on weevils from the sweepings of corn-ships (known as "Indian dust"), taken from imports from the East Indies. These were sent me on the 5th of September, 1877, and at first the weevils refused to have anything to do with the English Wheat I sprinkled amongst them, straggling away in preference to the broken Maize scattered amongst it; but on the 19th of September, the punctures where the egg had been inserted were plainly noticeable.

These were on the concave side, and usually at the end of the grain occupied by the germ, where the outside is softest. On the 9th of March of the following year I found numerous Wheat-grains, each containing a maggot. These were of various sizes, from about the sixteenth to under the eighth of an inch in length, white, thick, and



Maggot and chrysalis, and jaws of maggot of Rice Weevil; all much magnified.

fleshy, legless, with chestnut head and jaws also chestnut-coloured; darker at the extremity; bluntly pointed and waved into two blunt teeth (see fig.). A few chrysalids were present, but at the above date they were all dead, in different stages of development. About a month later (on the 11th of April) no more chrysalids had formed, and at the beginning of June I only found two more beetles, and though

about one grain in ten had a tenant, for the most part it was only still in maggot state and often stunted, and in the few grains which contained a developed beetle this was usually small, distorted and dead. On the 6th of October following I found numerous beetles, but still not by any means corresponding in number with the infested grains of corn, and some of these beetles only about half the usual size.

In the early part of the experiment I placed the beetles in reach of fire-heat, which threw them into a very active state; afterwards they were in the temperature of a living-room constantly used,* and as even with this the result was that in the course of fourteen months I only obtained one brood, and this not as numerous as the parent weevils, and even of these some were half-sized or variously not in a natural condition: *from these points it appears that the non-breeding of this Spotted Granary Weevil in England to any hurtful extent is much confirmed.* This kind is usually easily known by the four lighter spots on the wing-cases.

In dealing with Granary Weevil, which are amongst the most common of our dry-corn pests, we have an enemy of which we know the history, and the habits, and that with due care it may be kept in check within our granaries, and be prevented from being brought to where it may be spread to them, likewise it *cannot* do harm to the growing crops.

But great risk, to my thinking, lies in the use of the foul screenings which get spread abroad in the country by reason of their cheapness. It is quite open to possibility that Hessian Fly thus came to us; because, as we now know, the chrysalids are to be found in the fine

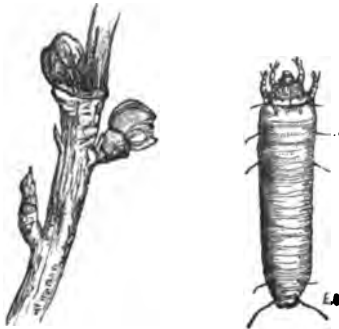
* For full detail of the experiments see the 'Entomologist' for February 1879, pp. 51—54.

siftings of small seeds and rubbish thrown down by the threshing-machines from infested corn, but also the coarse screenings out of bodies larger than the corn itself are greatly to be mistrusted. Amongst these I have found the most various things, as short pieces of straw that might or might not have maggots within, knots of maggot-web, ergot, &c., showing that the worst field-attacks may thus be propagated from the insects developing from this source.

It may certainly be laid down that, wherever these cheap foul screenings are allowed to be used, the holder must not be surprised if grave disaster should follow in the train.

BLACK CURRANT.

Gall Mite. *Phytoptus ribis*, Westwood.



PHYTOPTUS (? species.)

Black Currant shoots with infested buds. Gall Mite.*

The Black Currant Mite has been reported as seriously troublesome to growers at various localities. With the increase of fruit farming the attacks of this *Phytoptus* or Gall Mite have either much increased or the observation of them has much increased during the last few years, so as to have become in some localities—as for instance in Clydesdale, as mentioned—a very troublesome evil.

In my Ninth Report I gave a description of the kinds of *Acarus* or Gall Mite, of the sub-family of *Phytoptus* which causes this Black Currant attack; therefore it is only necessary to mention that it is

* The figure given is of the Birch *Phytoptus*, and shows the general appearance of the *Phytopti*. I am not aware that distinctions in form between the two kinds have been noticed.

much too small to be seen by the naked eye, and is of the shape figured p. 77, that is, cylindrical, rather smaller towards the tail extremity, and furnished with only two pairs of legs, placed at the fore part of the body. It has also some large strong bristles, which may help it in movement. *Phytopti* multiply from eggs, and are the same shape and possess the same number of legs throughout their lives. They live together in large numbers, and in the case of the Black Currant do damage by causing a swollen growth of the buds, which ends in causing them to prove abortive. The presence of attack may very easily be known by the appearance of these buds, which are spherical or variously swollen or distorted; sometimes they are few in number, and the growth of the shoot on which they are placed is not distorted; sometimes as many as six or seven swollen buds may be found on about three inches of shoot.

The two following observations give a very clear description of the main points of the *Phytoptus* attack, and also of the great difficulty of getting rid of it when once it has fairly taken possession.

The following note was sent me on the 15th of March, by Mr. W. James Le Tall, from Hackenthorpe, West Sheffield.

"I have been advised to ask if anything is known of an insect which infests Black Currants and destroys their power of fruit-bearing, the buds of the infested trees being very much enlarged in spring, and never bursting forth into buds and blooms at the usual time. If the disease once gets into a plantation of Black Currants, it passes from tree to tree till all are infected, and from being a fruitful plantation it becomes in three or four years almost fruitless. At this period of the year the buds of the infested trees show unnatural vigour. An insect at this time of the year is also found plentifully in the infested buds; and I should be glad to know if anything is known of its life-history. To me it appears about from 1-80th to 1-100th of an inch long, and if seen with a half-inch object-glass it appears to have four legs at what I take to be its anterior part, and the body is pyriform, with, at the smaller end, some arrangement by which it seems to be able to affix itself after moving with its four legs."

"No cure is known for the disease here but destroying the infested trees.

"This disease I have noticed for fifteen years, but now it is very much more prevalent, and threatens to destroy the Black Currant crop in this vicinity."

Specimens of remarkably bad *Phytoptus* attack were sent me on the 26th of May, from Midway Paynton, Cheshire, by Mr. E. Dowlen, with the observation,— "Enclosed are some branches of Black Currant, in which the leaf-buds are all ruined owing to the presence in them of small white grubs. In this district, during the last few

years, the Black Currants have suffered severely from this pest, the entire stock of trees in some cases having been completely ruined, and fresh stocks which have been put in, though brought from a distance, have shared the same fate." . . . In this case, as in that above reported from Clydesdale, it appears that the mites have taken such complete possession as to make land useless for Black Currant growing without something being done. The branches sent showed very bad attack of the *Phytopti*. As many as seven diseased leaf-knobs, from a quarter to three-eighths of an inch across, were on one of the Black Currant shoots, which were only about three inches long. Other shoots had seven or eight of the swelled leaf-buds on them, and with them were sent specimens of Hazel, also badly attacked by *Phytopti*, which could be plainly seen with a one-inch object-glass.

The following note, sent me on the 24th of December, by Messrs. Dicksons and Co., 1, Waterloo Place, Edinburgh, also shows strongly the great difficulty of getting this mite out when once it is established. Messrs. Dicksons enquired whether I could suggest "any cure for the 'mite,' as it is called, which attacks Black Currants in some parts of the country. A grower in Lanarkshire informs us that the buds become abnormally enlarged, and the pest, whatever it is, has so thoroughly spread over the district in the Clydesdale orchards that it is considered hopeless to attempt to grow Black Currants at all there. Our correspondent thinks it must be in the ground, as he has got plants successively from England, Scotland, and Ireland with similar results, and they all become affected in the same way as those which had been taken out. Once, when he removed the old soil and replaced it with fresh material, the pest did not attack the bushes till the third year after they were planted, but then those bushes were bad as any that had been there before; apparently, cutting off the affected branches would not do any good, as young shoots coming up from the ground are badly infested the first year. The affected bushes produce no fruit. Could anything be applied to the soil to destroy the pest?"

I am not aware that the general habits of the Black Currant Mite have been observed, but in the case of *Phytoptus* attack to other plants I have found them straying about on the leaves, and in the case of Birch *Phytoptus* I have found the mites active enough to lay eggs in winter; therefore it seems likely that the surface soil where many Black Currants are grown may easily get infested by the leaves and many of the mites falling to the ground together in autumn; and as they are still active they can creep about at pleasure, and more particularly lodge themselves together with leaves and rubbish that collect amongst the lowest part of the branches at ground-level. It would appear likely that skimming off just the top surface with the old leaves, as soon as they have fallen in autumn, would do a deal

of good, of course taking care to work well in round the neck of the branches at ground-level so as to get out all harbour for the mites.

If to this was added, smearing the lowest part of the branches for about two or three inches high with the material called "Davidson's composition" (which answers excellently for keeping insect pests from crawling up trees or plants), it would appear impossible that attack could be started from mites crawling from the ground. Where bushes are only slightly infested, breaking off the swollen buds and *destroying* them should be carefully looked to. It is little use breaking them off if they are dropped about, and also good strong syringings with soft soap for the main ingredient would be very useful. These would run down and lodge in all the chinks and crannies; under rough bark between buds and shoots; in the angles of the branches; in short, just the place where the straggling Currant Mites harbour, and would kill what were there, and likewise by the greasy and deterrent mixtures harbouring would make their hiding-holes quite unattractive and unsuitable for shelters.

The following recipe, sent me in 1885, by Mr. Arthur Bull, of Cottenham, Cambs.,* would be serviceable:—

"Two parts of sulphur and three parts lime boiled together in water (2 lbs. sulphur and 8 lbs. lime, 8 gals. water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes."

Or, to save the trouble of boiling the lime, sulphuret of lime may be used—4 ozs. of the sulphuret and 2 ozs. of soft soap to each gallon of water. The two ingredients should be well mixed before the addition of the water, and be stirred as the water is poured on at *boiling* heat. This may be used as a syringing, or in thick condition run down at the bottom of the bushes to choke and poison what lodge there.

Where bushes are badly infested they should be destroyed, but this should be done carefully. If the branches are just carelessly thrown for a while on the beds, the mite is very likely indeed to spread from the broken bits to the healthy bushes. The branches should be *cut and immediately carried away* and burnt; the stump should be grubbed out and also burnt; and the surface soil displaced in the operations should *not* on any account whatever be spread about, or it will probably convey the mites with it. If it is turned down again into the hole, and some fresh gas-lime spread on the spot, this would make all safe, and probably sprinklings of gas-lime under the bushes, or thrown in a ring round the bottom of the branches would be very useful. Care should be taken that it did not touch the bark, and that

* See 'Ninth Report on Injurious Insects,' p. 35.

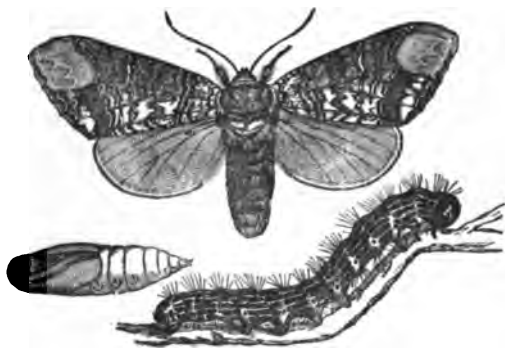
it was applied by some one who was acquainted with the destructive nature of the material if used too freely.

It does not appear that this *Phytoptus* or Gall Mite attacks Red or White Currants, therefore (so far as we know) replacing the destroyed Black Currant-bushes with the other kinds would be of service. Likewise, as this attack spreads to such a serious extent where Black Currant bushes are grown together in large areas, as in fruit farming it might be worth consideration whether growing the different kinds in alternate rows or plots would not be desirable.

There are many different kinds of deformed growth which are caused to various plants or trees by Gall Mites or *Phytopti*. The well-known distorted growth of the twigs of the Birch into great masses of a foot or a yard in length, popularly known as "witch-knots," is one form; the "nail galls," like small crimson spikes, found on the Maple and Sycamore leaves is another form; and the Gall Mites which cause them are considered to be of different species, but whether they limit their attacks entirely to their own food-plants does not appear to be known with absolute certainty at present.

ELM.

Buff-tip Moth. *Pygæa bucephala*, Stephens.



PYGÆA BUCEPHALA.

Female moth, caterpillar, and chrysalis.

The Buff-tip Moth caterpillars often do great harm to the leafage of various kinds of trees. From their great size and voracity the presence of attack is very plain, and though there is from their habits every likelihood of this attack being repeated, if nothing is done the

recurrence may be easily prevented. For several years I have seen the caterpillars regularly straying about towards autumn near lime trees in the neighbourhood of Isleworth ; and they have been forwarded to me as causing damage in the Royal Botanic Gardens, Kew ; but I have never seen them in such numbers as in the bunches of specimens forwarded to me last season.

The above figure gives a good representation of the full-grown caterpillar ; the colours are black and yellow, with black head, black horny plate above the tail segment, and orange transverse bands on each ring. The large moth is easily known by the black or rusty lines and figures on a pearly or purplish ground, with a large yellow or "buff-tip" to the fore wings, whence the moth takes its name ; the hinder wings are whitish.

On the 27th of August I received specimens from Mr. T. Cradock, of Ockbrook, Derby, which he had taken from a broad-leaved Elm. He mentioned, "when I saw them first, about 12 o'clock this morning, they were in hundreds on one large branch, and had entirely stripped that one branch of its leaves. It was that which attracted my attention to them. On going again this evening, about 6 o'clock, I could only find a comparatively small number ; there might perhaps have been then only four score."

The above description is characteristic of the method of attack. Sometimes the whole tree is stripped of its leafage, but more commonly only the twigs of the higher branches or those outside are stripped ; and the method which is said to answer best to get rid of the caterpillars is to jar the boughs or shake the infested twigs so sharply and suddenly as to make the caterpillars fall. Where there is a garden-engine at hand or means of throwing water, probably nothing would be so effective as good drenchings.

When the caterpillars are full-fed they creep down the trees, and turn to dark brown chrysalids in the dead leaves or rubbish beneath the tree or just below the surface of the ground. If these are left undisturbed, naturally the moths, which come out from them in the following June, fly up to the tree above and start attack again. The eggs are usually laid about the middle of the summer in patches on the upper side of the leaves.

Where trees are known to be infested it is serviceable to make a circle of gas-lime, or of a ring of wet tar run out on a rough rope of hay, or of anything else that the caterpillars will not creep over ; thus they are confined in a narrow space at the foot of the tree, and if the surface of the ground is skimmed off at leisure during the winter the chrysalids can be thus readily got rid of.

The Evergreen Oak has not, so far as I am aware, been noticed as one of the trees which they infest ; but in the course of last October I

received specimens of this caterpillar from Kilmacurragh, Rathdrum, Ireland, which were forwarded on twigs of this tree, with a note that it was the first time the sender had seen this kind on Evergreen Oak. The caterpillars were remarkably fine specimens, and were feeding voraciously on the Evergreen Oak sent with them.

HOP.

Hop Aphis. *Phorodon humuli*, Schrank; *Aphis humuli*, Schrank.

During the past year the subject of the migration of Hop Aphis from Plum to Hop in the early part of the year, and from Hop to Plum in the late part of the season, has been so thoroughly investigated as to make it appear fully proved that this regular migration to and fro does take place. It has long been considered by many Hop growers that migration occurs, and it has also been definitely stated to be the case by observers competent to distinguish the precise kind.

So long ago as 1854, Prof. C. L. Koch recorded that he found Hop Aphis on Plum and Sloe; and it is worth notice that he mentions the great numbers in which it was found on these trees or bushes in the latter part of May, and that he gives the description of this Hop Aphis in its various stages (that is female, young, &c.) from what he saw on the Plum and Sloe; and after details of these, then he adds . . . "In the month of June this kind of Aphis quits the leaves of the Sloe" (or wild Plum) "and then betakes itself to the wild and cultivated Hop, where it settles on the under side of the leaves, sometimes in immense numbers."* This and other observations, unnecessary to repeat here, show spring migration on the continent of Europe.

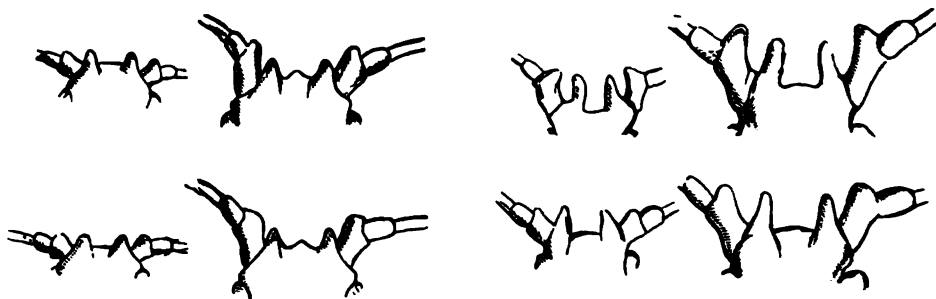
In this country, after long examination of the Aphis in the conditions commonly called Fly and Louse (that is winged and wingless), and including young, more advanced young, and females, I could not find that any difference in form of the characteristic points of structure (by which the Hop Aphis is known) were to be noticed between the kind technically known as the *Phorodon*, which was found on Hop, and that found on various kinds of Plum.†

The figures show the almost exact similarity of shape in the frontal tubercles, and of the swollen or toothed lowest joints of the horns of the Hop and the Damson Hop Aphis, that is *Phorodon*, found

* 'Die Pflanzen Lause (Aphiden),' von L. C. Koch, pp. 114—116.

† See Eighth Report on 'Injurious Insects' (Hop Aphis), pp. 43—56, with figures to show similarity of form in forehead and base of antennæ between the specimens taken respectively from Hop and Plum.

respectively on Hop and Damson or Sloe, in their conditions of young of two ages and of winged and wingless females. These were figured from life by myself; the reader will observe that the upper row was drawn from Hop Aphides, the lower from specimens taken from Damson or Sloe.



PHORBODON.

Young.

Winged females

More advanced young. Wingless females.

The upper row from Hop; the lower row from Damson or Sloe.

The observations sent in and the specimens all appeared to point, as I then said, that there was good reason for believing "*That the great attack, which usually occurs in the form of Fly about the end of May, comes on the wing from Damson and Sloe as well as from Hop, and that the Hop Aphis and the Damson Hop Aphis are very slight varieties of one species, and so similar in habits as regards injury to Hop that for practical purposes they may be considered one.*"

It is of very considerable importance to prove these points certainly, as thus it is proved also that Hop-grounds near Plum and Damson orchards and Sloe-hedges are likely to be infested; and also that where there is presence of these orchards, there washing betimes will prevent much attack going on to the neighbouring Hop-yards, and also that it would be very desirable to substitute some other plant than Sloe for hedges.

The spring migration to the Hop appeared to be certain, but the autumn migration had not been so fully entered on; and therefore the abstract of observation given below, partly taken in America and partly in this country, will be found to be of much value.

In the American States the Hop suffers severely from Aphis, and consequently careful investigation of the above points have been made by Prof. Riley, Entomologist of the Department of Agriculture, U.S.A., and under his direction for practical use. During his recent stay in England I had the advantage of personal communication with Prof. Riley on the subject, and he favoured me with a copy of his paper, read before our own British Association at Manchester, and

likewise was good enough to write me the main points of his investigations in Kentish Hop-yards during his stay in England, which, it will be seen, clearly prove egg-deposit of the Hop Aphis taking place on Plum in autumn.

Prof. Riley reported before the British Association as follows* :—

"*Phorodon Humuli* hibernates in the winter egg-state, this egg being fastened to the twigs (generally the previous year's growth) of different varieties and species of *Prunus*, both wild and cultivated. The egg is difficult to detect, because it is covered with particles which resemble the bark in colour and appearance. It is usually laid singly, and when freed of disguising particles is seen to be ovoid and 0·04 mm. long."

From Prof. Riley's report it appears that the annual life-cycle is begun on Plum by the female, the mother of the coming tribe being hatched from the winter egg. She is described as stouter than the individuals of any of the other generation, and as having legs, horns and honey-tubes relatively shorter, and the tubercles between the horns as hardly observable. The colour pale green, with bright red eyes and faint dusky feet.

Three generations are stated to be produced on the *Prunus* or Plum, of which the third becomes winged, "and instinctively abandons the Plum and migrates to *Humulus*,"—that is to the Hop. Here Prof. Riley makes the important observation, "*The habit of moving from plant to plant after giving birth to an individual, and thus scattering the germs of infection on Humulus, is well marked in this winged generation.*"

In the observations reported by Prof. Riley which were made in America (on growing plants and in *vivaria* at Washington, and checked by others made at the same time in Hop-yards at Richfield Springs in New York State) it was considered to be the case that "during the development of the three Plum-feeding generations the Hop is always free, and subsequently, until the return of migration, the Plum becomes more or less fully free from infestation by this species."

[In the above point I incline to think that there is a difference between the condition of Hops in America and England, as regards freedom from infestation until it comes from Plum on the wing, and this for reasons to be presently given.—Ed.]

The existence of many generations on the Hop during summer we are all well acquainted with, but during Prof. Riley's stay in Europe, and more especially in England, he personally observed the point not previously worked out, of the autumn migration of the Hop Aphis

* The above extracts are taken from the "full abstract of a paper read before Section D of the British Association for the Advancement of Science, Manchester, Sept. 3rd, 1887."

(the *Phorodon Humuli* that is) from Hop to Plum. The accounts of this he published at the time in more than one of our leading journals, but I give a few of the most important points, from communications which I have been favoured with from himself, showing the progress of the movement on to Plum in the autumn.

On September 15th Prof. Riley wrote me from Maidstone,—“As I anticipated, I have found *Phorodon Humuli* just migrating from Hop to Prune, and first wingless generation on Prune, but no eggs yet.”

On September 24th also, writing from the neighbourhood of Maidstone, Prof. Riley noted, “*Phorodon* swarming on Plum-trees here.”

On October 1st Prof. Riley wrote me that he had now brought the *Phorodon* investigations to a successful close, and completed the whole life-cycle. “Last week pairing was everywhere going on, and on Saturday I noticed the first eggs. The Plum-trees are now being rapidly stocked. The male is winged and the female wingless, as I had surmised, and the first generation on the Plum is the sexed one.”

Further, Prof. Riley informed me that the Aphis eggs (which he had seen on the Plum-shoots) became black. This agrees with information sent me by various correspondents during the last few years, that they had noticed black eggs, of which they sent me specimens, from which they had no doubt they had hatched Hop Aphis.

We have now got the complete circle of observation of the life-history of the Hop Aphis, as far as Hop and Plum and Sloe are concerned; and it appears plain that washing in the Plum orchards betimes will cut off one great cause of infestation to the Hop, but in a further consideration, although I scarcely like to venture to differ in any way with such a thoroughly well-skilled observer as Prof. Riley, yet, as we have discussed the point much in friendly conversation, I will venture to say that I do not myself think that in this country *the whole of the attack* comes on the wing from Plum, Damson, or Sloe.

I think this because we have found Aphides (that is, wingless females and lice) on Hop as early as the end of March and the beginning of April, long before the attack coming on the wing made its appearance. Also in the Stoke Edith experiments, made in 1884,* it was found that in the case of the Hop-hills which were dressed with applications to keep the Aphides from coming up from around the Hop-plant, the vines on these hills (more than six hundred in number) were free from attack, *although the rest of the Hop-yard was infested*, until the fly came on the wing about the end of May.

This matter of the amount of attack to be found early in the season on Hop needs further enquiry, and I should be very much obliged by infested shoots of Hop being sent me as early in the season as they may be observed, for thorough identification of the species.

* See my ‘Report on Injurious Insects’ for 1884.

K A L E.

White Cabbage Butterflies. *Pieris brassicæ*, Latr., and *P. rapæ*, Latr.



PIERIS BRASSICÆ.

1, Female of Large White Cabbage Butterfly; 2, eggs; 3, caterpillar; 4, chrysalis.

The caterpillars of the White Cabbage Butterflies were destructive last year at various places, on Kale, Cabbage, and "Green-crops." They were reported as "more common at Staines than they had been for five or six years."

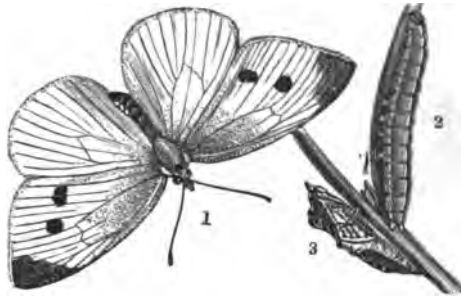
At St. Alban's I found them on Cabbage or Cauliflower plants in my garden at Torrington House, when I moved there in September, in such numbers as to attract the attention of every one who came near. The position was very warm and sunny, sheltered from the north by a high garden wall and the ground sloping rapidly down to the valley with a S.S.W. exposure, and the caterpillar swarmed to such an extent that some of the plants were eaten down to complete skeletons. This was a case in which hand-picking would have saved the crop, but being much occupied from change of residence I could not attend fully. Many of the caterpillars, as is their custom, wandered away, and, after crawling away about the width of the garden down the hill and over the wall, went into chrysalis on the sunny side.

This habit of the caterpillar is one great means of checking increase; it chooses such places as sheltered spots on walls, under eaves and copings, in garden sheds, and under old wood, &c., that may be lying about, to change to chrysalis in. There it hangs itself up by

the tail, and, after spinning some threads for support, throws off its caterpillar skin, and appears as a pale green chrysalis spotted with black. The autumn brood passes the winter in this condition, and from these chrysalids the butterflies come out in spring. It is therefore desirable during winter to examine likely places about kitchen gardens for the chrysalids to be found in and to destroy them. They may sometimes be thus collected very rapidly in large numbers.

The caterpillar of this kind—the Large White Cabbage Butterfly, figured above—is, when full-grown, bluish or green above, with yellow line along the back and each side and large black spots.

The caterpillar of the Small White, figured with its butterfly below, is velvety green in colour, without black spots, but with three yellow lines, and the chrysalids are fleshy brown, freckled with black.



PIERIS RAPÆ.

1, Small White Cabbage Butterfly; 2, caterpillar; 3, chrysalis.

The same methods of prevention and remedy are for the most part applicable to both the Large and Small kinds.

The following note, from Mr. W. W. Glenn, of Barking, Essex, shows the great amount of caterpillar presence, and also that they may be kept down by hand-picking:—

“Our main plague this season was the Cabbage caterpillar, whose activity was surprising, and who would have done me considerable damage, except that I watched his movements with an army of boys, who picked him off wherever and whenever observed. We had to keep a sharp look-out over three or four fields, and retrace our steps now and again as fresh ova were hatched. By careful and close attention the damage was minimised, and the loss brought within reasonable compass.”

In the following notes of bad attack on Kale sent me by Mr. Joseph Ackworth, of the Howberry Farm, Erith, it will be seen that two methods of prevention occurred, one by weather-influence, one by attack of parasite insects: and as far as appears, both these methods might be turned to account artificially.

On the 29th of July Mr. Ackworth wrote me, with a specimen accompanying, that the attack "at the present time is doing us incalculable mischief among nearly all our green crops. . . . We have spent a lot in hand-picking and yet they swarm, as I believe fresh broods are continually hatching.

"What I want more particularly to ask your opinion of, is the mass of yellow silky substance we are now finding, wherever the caterpillars are, and invariably one is stretched across these and half dead; and in one instance there appeared to be small grubs or maggots hatching therefrom and feeding on the caterpillar. At first, when hand-picking, we smashed these, but we are now perplexed as to whether this is advisable."

The above is an excellent description of the early condition of a small, black, four-winged, parasitic fly (scientifically the *Microgaster glomeratus*, Linn.), which is one great means of checking increase of Cabbage Butterflies. This parasite ichneumon fly lays its eggs in the butterfly caterpillar, within which the parasite maggots feed, until the caterpillar on which they are preying has reached its full growth, or more, as these caterpillars full of maggots may often be known by their large size. The maggots then come out, and each spins a small yellow case like a small silkworm cocoon, and the infested caterpillar dies just when otherwise it would have been turning to chrysalis. The little clusters of yellow cocoons may be seen in great numbers where there are many Cabbage caterpillars and should never be destroyed, as the flies from them will do good again with the next generation of caterpillars. The clusters or bunches of cocoons may be easily collected and thrown aside under boards or in sheds or any convenient shelter, without needing any further trouble.

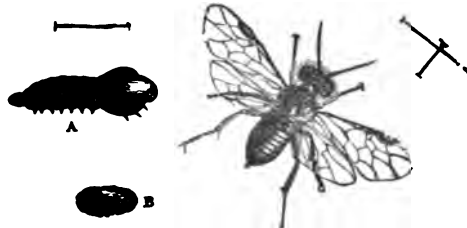
On July 29th Mr. Ackworth wrote that, "thanks to the ichneumon fly so many caterpillars were found dying, that from this, with a heavy recent shower, the field was then nearly clear of the pest"; and he further added, "we continued hand-picking the smaller plants, and I hope now we have got through the worst of it."

The help given by the heavy rain-shower is well worth notice. Sudden rain will sometimes so affect Cabbage caterpillars that they become mere lax skins, with cream-coloured fluid within, and it would be well worth trying, where water and means of applying it is at hand, whether thorough drenchings applied by engines would not have a similar effect.

Waterings or "washings" of weak brine or soapsuds have been found useful, and in the case of the Large Cabbage Butterfly, which lays its eggs in patches under the leaves, as figured at 2, p. 87, it would be worth while to have these looked for and the bits pinched off and destroyed.

PEAR.

Slugworm of Pear and Cherry Sawfly. *Tenthredo cerasi*, Linn.



TENTHREDO CERASI.

Slugworm and Sawfly magnified, with lines showing nat. length; cocoon.*

During the past season I received an unusual number of applications regarding Pear Sawfly caterpillar. These caterpillars are exceedingly voracious, and whilst with a little care they may easily be got rid of, or the chrysalids to which they turn may be cleared from the upper part of the soil beneath the infested trees, on the other hand, if nothing is done by way of remedy, the foliage of the trees is greatly injured, and the attack is likely to recur year after year.

They may easily be known by their peculiar shape and slimy appearance, from which they take their common name of "Slugworm." Until their last moult they are of a blackish colour and lumpy shape, much like that of a slug, swollen or enlarged behind the head, or may be at the middle or nearer the tail. They have ten pairs of feet,—that is to say, three pairs of claw-feet, which are on the three segments next the head, and seven pairs of sucker-feet, so that each segment excepting the head and tail, and the fourth segment from the head, has a pair of claw- or sucker-feet, but from the small size of the grub they are little noticeable. When full-grown it is about half an inch or rather less in length, and looks as above-mentioned somewhat like a slug, or still more like a lump of wet blackish dirt run together, and largest at one end; but at this stage of life the Slugworm entirely changes its appearance. It casts its skin and appears as a yellowish coloured caterpillar, no longer slimy nor smooth, but wrinkled across.

The caterpillars now go down into the ground and there they spin themselves up in cocoons, from which, in the case I am quoting from, the Sawflies came out in the following year in July.

* The above very excellent figure is from one in Vol. ii. of the 'Gardener's Chronicle,' which I was favoured with permission to use by the Editor some years ago.—E. A. O.

The figure at the head of this paper shows the form of the Slug-worm and cocoon, and likewise of the Sawfly, with lines showing the natural length; and I have had plenty of specimens of the Slug-worms, but the precise determination of the species, which was first described in England by Prof. Westwood, is involved in so many difficulties, that I refer the reader who wishes to go into these points to the work below cited.*

The first note I received of this attack last year was sent on the 21st of July, from Hencotes, Hexham, by Mr. W. A. Temperley, who desired information regarding the "black, leech-like caterpillar" of which specimens were forwarded. He mentioned, "It made its first appearance here last year, but is swarming on some of the wall-fruit trees this season, Cherry-trees especially, and has destroyed the foliage. It first appears like a bright speck, almost invisible to the naked eye.

On the following day, July 22nd, specimens of Slug-worms in different stages of growth, were sent me from Dorchester, by Mr. Geo. Oldfield, agent for Mr. W. E. Brymer, with a note that this "jelly-like grub" was doing great damage to Pear trees in the gardens of Mr. Brymer. It was observed that, "the grubs were in hundreds on the leaves, particularly on the top of espalier and wall-trees, and seem to suck the juices from the leaves, which turn brown and die."

On the 2nd of August specimens were forwarded me, together with leaves gnawed on the upper surface in small dots or spots up to patches of half an inch to an inch and three-quarters in length. These were sent from Bryntirion, Bridgend, Glamorganshire, by Mr. W. Prichard, with a note that the small grubs, of which a sample was enclosed, had in about three days devoured the leaves of two Pear trees, and were then attacking a Quince. "The same grubs appeared on the same trees last year, clearing them entirely of their leaves."

A little later on, August 23rd, specimens of the same attack were sent me by Mr. M. Edmonds (by desire of Mr. Elwes), from Colesbourne, near Cheltenham, with the observation that the grub had "attacked a Pear tree, situated at the east end of the house, for three successive years," and entirely spoilt the fruit. "Every leaf is perfectly brown as the one I send to you."

On September 18th, Miss E. Culverhouse sent Slug-worms from The Hundred Acres, Sutton, Surrey, with a note, "They were now attacking in large numbers the leaves of a row of Pear trees trained against a brick-wall, east aspect, chalk soil. The upper sides of the leaf in full hot sunshine are covered, but *not one* on the under; . . . the

* Mon. of the Brit. Phytophagous Hymenoptera, by P. Cameron (Ray Soc. 1862), pp. 226 and 228.

leaves when attacked soon turn brown, wither, fold, and drop as in winter."

On September 28rd, Miss Culverhouse wrote that the insects had largely increased in numbers, but that the remedies which I suggested (noted below) had been tried; and that the liveliness caused by the application of lime-dust, and consequent exudation of slime, soon disappeared on a second application, and their eradication soon would be complete.

On September 15th specimens of this same kind of shiny caterpillars were sent me from Serlby Hall, Bawtry, Yorkshire, with the observation that they had devastated a long wall of Pear trees, so that the leaves had turned quite brown and were falling off.

The Slug-worm attack can be checked by dusting or syringing. The caterpillars, if annoyed by throwing a caustic powder on them, such as quick-lime or gas-lime, can throw it off at first by exuding a coating of slime, and thus as it were moulting off the obnoxious matter; but they cannot keep on continuing this process; therefore a second application of the powder (of course soon after the first) takes effect and kills them. If a good time is allowed to elapse between the dressings, they will have regained the power to produce the slime exudation, and the dressing will do little good. Tobacco-water, lime-water, and syringings are all stated to be of service, but it is desirable the syringings should be applied early or late, as before 7 o'clock in the morning or 5 in the afternoon.

The recurrence of the attack, which, as it will have been observed in the above notes, is a very common circumstance, may be prevented by skimming off the surface of the ground and removing the cocoons. These may lie below the surface at from one to about four inches deep, according to the state of soil. If the earth is stirred over by a competent observer, little balls, probably much resembling the colour of the earth they are in, will be found, and may at once be identified by just tearing the spun case open, when the caterpillar or, later on, the chrysalis will be found within. When once the observer has found how deep these cocoons lie, it is easy to have the surface-soil removed to just below that depth, and by removing this and *destroying it, with the cocoons within it*, the infestation may be fairly carried out of the place; but care must be given that the cocoons *are* destroyed, or otherwise the Sawflies that hatch out of them will fly back to the trees and begin the attack over again.

It might probably save a deal of trouble, in the case of espaliers or wall-trees, when the flies are seen to be infesting them, to run a length of tarred cloth or paper beneath the boughs, and shake them well morning or evening. The flies are stated to fall and to remain motionless for a short time; this would allow of them being stuck fast to the tarred surface which they fell on, and would save much egg-deposit.

PINE.

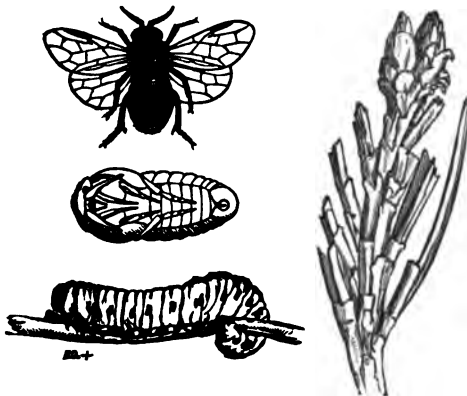
Small Pine Sawfly. *Lophyrus* (? sp.).

On the 28th of June I was favoured by specimens of Sawfly caterpillars, sent me from Happy Land Park, Bishop Auckland, Co. Durham, by Mr. J. Ilderton Leaton Blenkinsopp, with the observation, "I send you a branch of a tree from a young plantation which is being devoured by caterpillars. They eat all the trees (Scotch Fir), excepting this year's shoot, which they leave." The twigs or sprays of Scotch Fir sent were fairly loaded with the masses of Sawfly caterpillars hanging one on the other, and the bark as well as the leafage was being consumed.

The caterpillars were 22-footed, and when they spun up formed a cocoon which was easily compressible with the nail, nearly three-eighths of an inch in length, of a yellowish colour outside, and lined within with two layers, separable with care from each other. The outer layer, next the cocoon, of a deep black grey colour; the inner layer, next the larva (which was still unchanged to the chrysalis state on January 25th), of a lighter grey.

When the caterpillars were sent me at the end of June they were just near the time of spinning up, and the colour varied a good deal both in tint and depth of tint, and some of the caterpillars were darker in the stripes than others, so that I could not identify the species beyond the fact of their not being larvæ of the common Pine Sawfly,*

* The figure of the common Pine Sawfly is appended, although it is larger and the caterpillar differently marked to the kind found at Bishop Auckland, just to give an idea of the form of this kind of Sawfly, and of its many-footed caterpillar.



LOPHYRUS PINI.

Pine Sawfly, caterpillar, and pupa, magnified; and gnawed Pine leaves.

as they were (amongst other points) much smaller. When they spun up they were little more than half an inch in length, with shining round black heads, three pairs of black claw-feet, and eight pairs of sucker-feet of a pale greenish colour. The general colour of the caterpillar was grey or greenish grey, with two darker stripes along the back (dividing the lighter grey into three stripes), beneath the lowest pale stripe a black stripe, and lower, just above the sucker-feet, a stripe of fine black spots. The caterpillars were pale green below, and above were transversely banded with rows of minute dark tubercles. In many points they much resembled the description of the *Lophyrus rufus*, Kl.; but not having developed the perfect fly I cannot tell the species with certainty. They did not appear exclusive in their food, for not having Scotch fir at hand I placed some *Arbor Vitæ* in their cage, and found them presently clinging to it, and marks of gnawing on the leafage.

On the 2nd of July many of the caterpillars had spun their oblong cocoons. These were from two- to three-eighths of an inch long, cylindrical, and bluntly rounded at the end, varying in tint from whitish to yellowish or brownish tints, and shining and membranaceous in texture. The caterpillars did not appear to be disturbed by being watched, and I was able to observe one specimen which had formed its case, excepting about a sixth part, which was needed to complete one side, still placing its thread. In this instance the house appeared to be finished by closing up at the side, the ends being completed previously.

About six days later, that is on the 8th of July, there were still some caterpillars that had not spun up, but a large number had formed their cocoons. These were for the most part placed amongst the leafage of the shoots on which they fed, or on the stems which they had stripped, which were laid on earth. Some were placed singly, but for the most part they were spun near or close together, in bunches,—one, or two, or three dozen, so as to form closely-packed lumps of cocoons, or sometimes two or three, or half a dozen together.

On application for further information towards the end of January in the present year, I was favoured with a number of cocoons, about half of which were empty; and also the following serviceable account of the attack, sent me by Mr. Geo. Burgess, agent to Mr. J. I. Leaton Blenkinsopp:—

“In reference to the Pine Sawfly, I observed the flies in the early part of May last year. In June the branches of the young Scotch fir trees were covered with caterpillars. . . . We applied quick-lime, also petroleum-oil, which made them leave the branches. I do not find so many cocoons under the trees where the lime and oil were applied. The grubs eat all the foliage of the Firs, except the young shoots that

came on the trees last summer. They left the trees when all the previous year's foliage was eaten off. There were no cocoons on the trees, but plenty about *half an inch under the soil* (under and near the trees). The trees are from six to ten feet high, and about nine years' growth. I have not seen any flies *since June* last; part of the grubs appear to have left the cocoons, but I cannot say if they are last year's cocoons that the Sawflies have come out from."

Rather more than half of the fifty cocoons sent me in January were empty, but from the irregular form of the opening I should conjecture that the caterpillar inside had been taken by small insect-feeding birds, as the titmice, or the field-mouse or field-vole, both of which are stated when pressed by hunger to feed on Pine Sawfly cocoons. In the specimens sent me I observed that the bark was gnawed, and Mr. Burgess remarked that from this cause "the turpentine or resin is now exuding from the small branches of the trees."

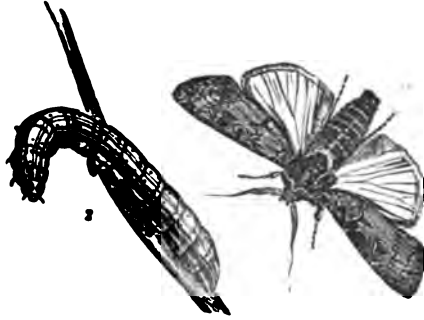
On a neighbouring property the forester got rid of the attack by employing people to crush the caterpillars which were devouring the foliage, in their hands.

The above information confirms what is considered one of the best methods of getting rid of the pests, namely, making the caterpillars fall by throwing dressings or by shaking. If this was done early in the attack, either over rough cloths, so that the fallen grubs could be collected and destroyed, or with bands of Davidson's composition (which would stick fast the grubs that tried to go up the trees again), daubed round the base of the stem, this would do a great deal of good.

The best time for shaking is said to be in the early morning, when the caterpillars are somewhat torpid; and it is stated, by Prof. Th. Hartig, that in German forestry one man to shake, with two women or children to spread a cloth beneath the boughs to catch the fallen caterpillars, will clear fifteen trees of twenty-five years' old before nine o'clock in the morning. Where the trees are small, the plan of crushing the caterpillars by drawing the shoot through a strongly-gloved hand answers well. Where circumstances permit of the upper surface being skimmed and the rubbish burnt with the contained cocoons, this is an excellent way to prevent recurrence of the mischief; but as the details of how to deal with this attack have been previously given, I mainly mention the above as being an instance of mischief caused by a somewhat different kind to the one most commonly observed, and of which I am endeavouring to complete the whole life-history.

TURNIP.

Turnip Grub. *Agrotis segetum*, Westwood.



AGROTIS SEGETUM.

Turnip (or Dart) Moth, and caterpillar.

The surface-caterpillars, and more particularly the special kind known as the "Turnip grub," which is figured above, together with the moth to which it turns, are now one of the regular insect troubles of the year. The grubs are of a dingy greenish or purplish brown or smoke colour, with two darker lines along the back and one on each side, but the colouring and depth of marking is very variable. They have a few dark spots on the segments, these spots being arranged transversely on the second and third segment from the head, which is brownish, and the grub is furnished with three pairs of claw-feet, and with four pairs of sucker-feet beneath the body, and another pair at the tip of the tail. The grubs when disturbed roll themselves up in a tight ring. The moth has the front pair of wings freckled and marked with black, or some shade of brown or greyish, and the hinder wings mainly of a dirty white.

The method of life is for the grub to feed during late summer and autumn, then during winter to feed or to hybernate in cells it makes well down in the earth, so as to protect it from too much cold; and if all has been favourable to the grub it comes out again in spring, and also feeds again, until in May or June it turns to a smooth brown chrysalis in the ground, from which the moth comes out in about three or four weeks. This caterpillar is now so regularly mischievous that the attack needs attention and experiment to find what could be done to check it. Excepting when very young, these caterpillars feed almost entirely below the surface of the ground, and are considered to attack almost any kind of plant that is eatable, but are chiefly injurious to Turnips, Swedes, and Cabbage. They have also been reported in the last few years as doing mischief to Mangold, Oat-plant, and Celery;

and either this kind or some of the nearly-allied kinds of surface-caterpillars prey on Leeks and Onions, Bean-plant, Spinach, Carrots and Potatoes.

As this attack has been so often entered on before, I give the following notes of locality of observation last year as shortly as possible, excepting where some special information is conveyed.

On August 11th they were reported to me as doing considerable harm to Swedes at Llansannor Court, Cowbridge. On the 11th, Mangold and Swede roots were noted as attacked on ground at Street, Somerset, by from one to four grubs at the root of the plant. On the 12th, Mr. J. Penrose Fitzgerald, writing from West Park, Midelton, Co. Cork, Ireland, mentioned the grubs as being found in the ground under Turnips and Mangolds, and occasionally under Potatoes. "They appear to eat the tap-root of the Mangold, which when attacked droops and falls. They are all through the district in light medium soils."

On August 24th, Mr. C. E. Mason, writing from Marton Grange, near Newport, Shropshire, reported that the grubs had attacked the Turnips in great force, and were of the same kind which had done so much damage to the Turnips in 1868, which was also a hot dry summer.

On September 4th, specimens of the grub, which were attacking and destroying Swedes in large numbers, "three or four to each root," were sent me from the Boyce Court, Gloucester.

September 6th, specimens of the same kind, which had destroyed a whole field of Swedes by burrowing at the roots, were sent from Reynolds Place, Horton Kirby, Dartford.

On September 18th, different ages of the grub, one about a third grown, were forwarded by Mr. Alex. Frazer from Westerfield House, near Ipswich, with the note, "They are eating off the thousand-headed Kale-plant just at the crown." A little later Mr. Frazer wrote, "We have gathered many hundreds of the grubs, one from under each Cabbage-plant that was eaten away, and have replanted them and all look well."

On September 18th, Mr. H. J. Sheldon, writing from Brailes House, Shipton-on-Stour, sent the following note of the great mischief which this same kind of grub was causing. . . . "But I am suffering terribly, and so are all my neighbours, from our Turnips and Cabbages being devoured by the enclosed grub. There are thousands of them, and they clear the ground of everything green. Would you kindly let me know what they are, and, still more, can you tell me how to get rid of them? They do not care for either lime or salt; and they will make a clearance of every Turnip and Cabbage in the country, if we find no means of destroying them." He further added, "They gnaw all the Swedes, Turnips, and Cabbage-plants through the root just

under the ground, and are clearing the fields of all plants of the sort."

A little later Mr. Frazer wrote the following note, showing the serviceableness of hand-picking, *if it could be managed at a paying rate*, the apparent uselessness of trying to kill the grubs with quicklime, and some remarks about the amount of attack being different on land differently prepared.

Mr. Frazer wrote:—"I have followed your advice and put some people on to hunt for the pests round the Cabbages with a knife and dig them up, but it is a very slow job. They find as many as five or six at nearly every plant that begins to droop, and doubtless there are countless numbers all about the ground.

"They have eaten off about four acres of Swedes and about the same quantity of Yellow Aberdeen Turnips, and are eating a lot of White Turnips, as fast as they get any size—and have eaten a large quantity of Cabbages. I replanted 40,000 and they have eaten them all again. I cannot think that lime and sulphur would be any good against them, as I have put quicklime on them, after digging them out of the ground and it does not kill them—their skins are too thick. They are only on the ground that has been kept cultivated and prepared for roots in the summer. I have four acres of Cabbage planted on Wheat stubble, just mucked and ploughed, and they have not touched them.

"They are only on all the land that was prepared for roots, and are eating a crop of Rape lately sown on some clay land that has been a dead fallow all the summer. It would require an army of people to hand-dig and pick them all over 100 acres of roots, and I fear they will do me irretrievable damage. I see they have also done a lot of harm to my neighbours.

"Unless one could get at them in the moth state, before they lay their eggs to form these grubs, I fear they are invincible."

On the 19th of September Mr. John Coleman sent specimens of the same caterpillar from Quarndon, Derby, with a note that the "large grubs were making sad havoc of everything green in the garden."

On the 20th a similar report was sent from the Manor House, Everleigh, Marlborough, by Mr. C. W. Curtis, of the grubs making great havoc of the Swedes on his farm. "Many acres have been destroyed, and I hear my neighbours have also suffered. They seem to attack the root in numbers, and as many as fifty-seven were taken from one Swede."

The following report was sent me on the 21st of September, by Mr. Lewis Danford, from Langley Bromfield, Salop, and I insert it at length, as, besides general points of interest, it is noted that mineral

superphosphate only was used for the Swedes. Mr. Danford reported—

“Field of seven acres. Has been under the four-course system to my knowledge for eighteen years; light soil. During the eighteen years, with exception of two straw-crops in succession, *viz.*, Oats after a light crop of Wheat (this two years ago), manure used good fold-yard with turnip manure, and for the present crop of Swedes mineral super only, some six or seven cwt. per acre. The Turnip-crop came up ‘patchy’ and was resown, but to no good; some three acres in the field are without roots; this in patches. On starting to plant Ox Cabbage this morning to fill up gaps, my men found the grubs as sent you; and on examining the field myself I found, with few exceptions, all the *large* Swedes, together with the small as those sent, eaten like those sent you. At a root I could always find two, and in many cases from five to nine grubs, including always a worm of the description sent you, located in the eaten hole of the root.”

A little later on Mr. Danford wrote that he tried my suggestion of collecting the grub from the root, but as they were in, some two to four inches, it was necessary to dig or remove the soil all round the Swede, then replace it. “This I found far too expensive an operation, so I have let them alone. I purpose next week to clear off what remains of the crop of Swedes and then scuffle the field some four or five inches deep. This will, I fancy, turn up the grubs on the surface, and the Crows, Rooks, and Plovers will doubtless feed on them. I could not turn pigs in until the crop was raised, but I shall do so when the field is scuffled. In a garden adjoining this field the owner tells me he finds numbers of grubs in digging his potatoes.”

On the 29th surface caterpillars were sent me from Kemble House, near Cirencester, with the note that they had entirely destroyed the Turnip crop round there this year; and on October 4th Mr. W. Biddulph further wrote of the grubs, “You cannot realize, unless you were to see them, what a pest they are. . . . Unless they are killed down this winter by the frost it will become a most serious matter.”

On October 8th Mr. J. G. Edwards sent samples of surface caterpillars from Broughton Stockbridge, Hants, with a note that they were “destroying Potatoes, Swedes and Cabbage, and other plants in fields and gardens, in a serious manner. Soot and salt have been tried in vain.”

The attack has continued during the winter, for at times previous to the beginning of January I have received information from Mr. F. W. Silvester, Hedges, St. Alban's, that surface caterpillars were still amongst his Turnips, and on the 16th of January the following communication regarding Turnip Grub, was sent me by Mr. Edgcombe Parsons, from Coates, near Cirencester.

Mr. E. Parsons requested information "respecting a plague of grubs from which my farm for some months has been suffering.

"They first made their appearance in June last (being then very small) in my root-crops, first attacking the leaves, afterwards the roots themselves. Some eighty acres were cleared entirely, not even a weed being left alive in the fields. Some Rye also was damaged in the autumn.

"I find now that the whole of my fields are infested with them more or less; the specimens I send you to-day I found after the plough a few days since; they were then in a lively state. . . . I find that they soon get back again into shelter, after having been turned out with the plough."

From the reports sent in during 1887, and the three preceding years, it appears that this attack is prevalent and destructive in the more southerly, eastern, and midland parts of England; but I do not find that notes have been sent in of it occurring farther north than Selby and Market Weighton, in Yorkshire, but as for remedies, or means of prevention, we seem just as far off as ever.

Various chemical applications tried in unmixed form have had no effect. Col. G. Coussmaker, of Westwood, Guildford, who has for some time paid much attention to the grubs, informed me that he "put several grubs into bottles of soot, sulphur, salt, but they only burrowed straight down, as if wishing to get away from unpleasant quarters, and remained coiled up at the bottom of the bottles. After letting them alone for two days I took them out seemingly uninjured, and have put them into a bottle full of earth. There they have been for upwards of three weeks, without a bit of green food, and are to all appearance as well and lively as ever."

On the 28rd of January in the present year, Col. Coussmaker further mentioned, "I told you that I found the crop dwindling away very fast, and that I got a family of Hop-pickers, father, mother and three girls, to pick the whole field systematically. They went over the seven acres twice, and in sixteen days collected sixteen quarts."

[We certainly greatly need some experiments tried about this yearly recurring pest, when the only known way of really extirpating it is one of such trouble and cost.—ED.]

One note was given regarding nitrate of soda having been previously used on the land without any immunity from attack following, and likewise that the grubs were as plentiful where a good deal of lime had been applied as elsewhere.

Other notes mention some good coming from the use of lime, but there does not seem to be any method which can be commonly worked at a paying rate, that can be trusted to as a remedy. Where it can be done, hand-picking is a certain way of getting rid of a large

amount of the grubs; and in cases like the field Cabbage-growing near Isleworth, may be presumed to answer as it is practised, but this is very different to working out the grubs from the large-leaved root-crops.

Well stirring the surface with hoes and drags has been found to answer, by throwing out a portion of the grubs to Starlings, Rooks, &c.; also *Pigs have been found to search busily for the grubs*, and here we may very possibly have one means of prevention that can be used at little cost.

It seems plain that the attack, which begins each year about August, cannot come from any other source excepting from the eggs laid by the moths which appeared a little before, about the middle of the summer, from chrysalids in the ground. We *know* that the caterpillars turn to chrysalids in the ground about May or June, and from all this it seems to me that where fields are known to have been infested it would be highly desirable, when they are being ploughed in the winter or spring following the ravages, to look whether the caterpillars or brown chrysalids were being turned up by the plough, and if so to have them hand-picked by children at so much a quart, or to turn on pigs to root them out.

The caterpillars or chrysalids *may*, of course, be more or less in many places, but we know that they *are* present in legions in many fields, and therefore that these infested fields are the places from which the moths will be likely to come out in corresponding numbers and infest the neighbouring fields; and therefore, as far as we see at present, it appears that we have no better way of forestalling attack than to look out for and destroy the grubs in infested land.

PART II.

OX AND HORSE WARBLER.—OX GADFLY.—“MURRAIN”
WORM.—SHEEP’S NOSTRIL-MAGGOT.

WARBLER.

Ox Warble Fly. *Hypoderma bovis*, De Geer.



HYPODERMA BOVIS.

During the past year a very great advance has been made towards proper attention being paid to getting rid of Warbles by the strong approval of the work set on foot for its destruction, given both by many of our most leading public agricultural bodies, and a very large number of private individuals connected with cattle, both in Great Britain and Ireland.

Our own Royal Agricultural Society, in co-operation with the Newcastle Hide Inspection Society, assisted greatly; likewise the Highland and Agricultural Society of Scotland, and the Scottish Chamber of Agriculture. Foremost amongst our English Chambers of Agriculture which aided in the work I may name that of Wisbech, Lincolnshire. The Butchers' Association of Birmingham, agents on various of the great properties, local agents, and cattle auctioneers and salesmen, and a very great number of cattle-owners and breeders, likewise aided, both in drawing attention to the importance of the work and in many cases by bearing witness to the ease with which this pest might be got under.

On the 10th of June Mr. J. McGillivray, Secretary of the Hide Inspection Society, Newcastle-on-Tyne, with whom I had for some time been in correspondence, wrote me that it had been considered by the Committee of the Society that it would be useful to have a few

warbled hides, both fresh and tanned, exhibited at the then forthcoming Show of the Royal Agricultural Society of England at Newcastle, in order to draw attention of the many cattle-owners who would be present at the meeting to the importance of taking steps to prevent the attack, and to let them judge for themselves of the serious loss occasioned by it.

The time having been passed at which, according to rule, applications for standing ground for exhibits could be received, some difficulty occurred, but, in consideration of the importance of the subject, special permission was obtained from the Royal Agricultural Society, and Mr. Jacob Wilson as Manager of the Royal Show granted an excellent site for the exhibition of warbled hides, and I had the pleasure of in some degree co-operating by lending specimens, &c.

The exhibits consisted of the hide freshly taken from the infested animal, so as to show the horrible state that such a hide presents where the flesh side can be seen with the great swellings containing the maggots more than an inch long, with the putrescent matter oozing where the swellings have been cut across and other evils no way observable on the outside of the hide of the living animal. Tanned hide was also shown, and hung against the light, so that the riddled state caused by the maggot holes could be clearly seen, and amongst these I exhibited the hide of a yearling (presented to me by Messrs. Parsons, of Taunton), which had died of mortification of the back, consequent on the presence of more than four hundred Warbles.

Maggots and other specimens were also shown, and copies of my own four-page illustrated note* giving an account of the method of life of the Warble maggot, and the very sure, cheap, and simple way in which the attack may be remedied and prevented, were presented to the visitors by one of the Staff of the Hide Inspection Society, and one of the members of the Committee devoted the greater part of four days to attendance in the tent to give all necessary information to visitors. The great interest excited by the exhibits was reported to me from various quarters, but is best conveyed in the following portions of a semi-official account with which I was favoured by Mr. Jos. G. Angus "As a Member of the Committee of the Inspection Society, I take considerable interest in the Warble question, and devoted the greater part of four days in attendance at the tent.

"I am sure you will be glad to learn that the experiment succeeded beyond our most sanguine expectations. Thousands of visitors I

* This four page note was printed for distribution, and as the main points of the method, and means of preventing or remedying attack, could hardly be put in fewer words, I reprint most of the "note" with the figures, as an addition to this paper, and shall be happy to forward copies gratuitously to applicants, or to offer any information on the subject,

believe realized for the first time the real loss to the community. From conversations I had with cattle-breeders, farmers and others, I think we may fairly expect as a direct result of the show :—

“1st. That a large number who have hitherto let things take their course will now take the trouble to destroy the Warble *when it is apparent on the hide*.

“2nd. Many will perhaps smear their cattle *before* the Warble is perceptible, and save the animals much unnecessary suffering.

“3rd. Not a few will in future adopt the best-known method of preventing the deposit of the egg. *I was glad to learn from several practical men, who in consequence of your published observations on the subject took precautionary measures two years ago, that they have cleared their farms of the pest, and believe that they run very little risk from their neighbours, as they do not think the fly travels far.* [I have placed this in italics to attract attention as it is confirmed by the accounts sent to myself year by year in every point, and that of the fly not travelling far should especially be observed.—ED.] Should this prove to be true, the extinction of Warbles need only be a question of time.

“Fortunately I had opportunities of seeing several of the large cattle exporters from the Continent, and was much pleased to find them so easily roused to the importance of drawing attention to the matter in their own countries. Of the thousands of live cattle brought to the Tyne yearly from abroad, a very large proportion are badly warbled.

“I am by no means scientific, but as a buyer of about 1500 to 1700 hides per week, I have the ravages of this pest constantly under my notice.”—Jos. G. Angus.

At the end of May Mr. F. M. Menzies, Secretary of the Highland and Agricultural Society of Scotland, favoured me with information that he had distributed 1800 of the papers above mentioned, and likewise Reports (giving the subject in fuller detail), to the Secretaries of Local Agricultural Societies in Scotland, together with a circular drawing attention to the importance of the subject, and further added from himself :—“I hope we may *rouse* the farmers to endeavour to *eradicate* the pest—it is so easily done :—my own cattle used to have plenty of them, but from squeezing out the bots they appear to have been got rid of, as I have not found a bot for some years.”—F. M. M.

A few days later Mr. D. Currer, the Secretary of the Scottish Chamber of Agriculture also wrote, mentioning that he had already been distributing some of the above papers “amongst my Directors, and some of the larger rearers, and breeders of stock,” and proposed to continue the distribution.

By the co-operation of the two above powerful societies, the subject

of Warble attack and the means of prevention were thus laid before agricultural centres throughout the whole of Scotland. In England several of the Chambers of Agriculture assisted in spreading information, especially that of Wisbech, under the Presidency of Mr. W. C. Little; and also with the very hearty co-operation of Mr. Geo. Moore, Hon. Secretary. On Thursday, the 10th of March, a meeting was held to consider the subject, and an able paper was read from Mr. W. Hatton, of the Firm of Hatton Brothers, tanners, Hereford, alluding amongst other things to the following very important point to which I have myself endeavoured to gain attention:—"As a tanner I cannot omit to mention the large number of yearlings lost annually, and generally supposed to have died from "black leg" or a chill, but I have seen hundreds of skins off such animals, most of them so thoroughly occupied by grubs along the back that one need not seek for any other cause of death."

Mr. J. A. Smith, of Rise Hall, Akenham (Hon. Secretary of the East of Suffolk Chamber of Agriculture), similarly forcibly, but taking different points, gave information as to damage caused by these most unnecessary causes of loss, and how easily the attack might be got rid of.

A resolution was passed, that "in the opinion of the meeting, the extermination of the Warble from the hides of the cattle in this district is highly desirable, and the members present pledge themselves to use their best endeavours to take steps to prevent the animals suffering from the attacks of the fly in the ensuing summer."

Mr. George Moore, the Hon. Secretary of the Chamber, had especially devoted attention to the subject for a long time previous to the meeting.

The Butchers' Provident and Trade Association, of Birmingham, as well as their President, Mr. T. J. Rodway, lent cordial and powerful assistance. The aid of the leading Agricultural and in many cases of the Local Journals has been widely accorded, and of enormous service. At the time of the Newcastle Royal Agricultural Show the Newcastle Journals gave much co-operation, and in Newcastle itself as well as its neighbourhood, I received great assistance in promoting the subject, and much time and thought were bestowed on it by Mr. F. C. Smith, who from his connection with Mr. Bolam, Cross House, Westgate Road, Newcastle, (Messrs. Bolam have been connected with the lead agency for about 150 years), and also from being personally interested in the subject, had great opportunities of collecting and dispersing information.

Mr. F. C. Smith, distributed copies of the papers to the tenants on estates under Mr. Bolam's management, who were much pleased to have them, and promised to act on the advice, and likewise to Bailiffs

and other out-of-door workers on the estates, and also supplied the Cattle Market, and left copies at the Farmers' Club, and at the working Mens' Club, which being placed in the Butchers' Market is much frequented by those interested in stock, and distributed and communicated in many other quarters likely to be serviceably influential in drawing attention to the subject.

Application was made to myself by several hundred correspondents, namely, cattle-owners, agents of large properties, cattle-salesmen and auctioneers; their letters in many cases contained accounts of the great prevalence of Warble in the district written from, and the loss to the owner on hide, milk, health or condition of beast for slaughter, according as he himself was personally interested in the respective matters. The printed note was requested for the information of the writers, and in many cases further supplies were desired for distribution to neighbours, tenantry, or customers; and in this manner about 21,500 copies of the four-page note, giving a short account of the main points of the attack, were distributed in the country, as well as many hundreds—probably about 8000—of the reports.

If it is considered that some four years ago the nature of Warble attack and the remedies were scarcely known in this country, excepting to a few especially interested in the subject, the fact that plain information is now at the command of everyone, and is being spread abroad with the approbation and under the auspices of the leading Agriculturists of the Kingdom, gives great reason to hope that we are in a fair way now to get the mischief attended to. One great point, that is still to be undermined with the uneducated, is the view that the attack is sometimes of incomprehensible origin, and shows a good state of the animal!

The following notes sent from various parts of the country refer to this extraordinary idea:—

"Having had to do with cattle, both when feeding or slaughtered as beef, all my life, I have for some time before reading your articles, seen how erroneous the old idea was that Warble maggots were 'Thriving Bumps;' whether the name is peculiar to this part of the country I do not know."—ERNEST MEAD, 1, Western Road, Tring.

"I find it most difficult to make them (Stockmen and Cowmen), believe that the maggots are not a sign that the beast is doing well; they call them Thriving Bugs."—K. M. COURTAULD, Cut Hedge, Halstead, Essex.

"I have some difficulty in getting the Warble grubs removed, as there is a notion prevalent in this district that a few of them make an animal thrive, and I know very few who take the trouble of removing them."—J. PUREFOY POE, Harley Park, Callan, Ireland.

"Having distributed your papers among my fellow-farmers, I am sure they will be well appreciated, for my own district is so very much infested with the Warble pest, and the old fashioned farmers call them Thriving Bumps, but I think they are *vice versâ*."—HENRY R. BROWN, Lodge Farm, Harefield.

Mr Richard Stratton, of the Duffryn, Newport, Mon., whose opinion on cattle matters is very valuable, wrote me :—

"I am glad indeed to hear that the Warble raid is progressing so well; everybody seems now to have heard of the pest, and of the simple means of prevention and cure, and those who don't act now, I am afraid won't. Still I suppose we must go on ding, dinging at them." And this is just what it is. The great cattle owners, heads of Societies, and so on, who have taken up the subject, and through whose observations (and information and courteous permission to make this useful information public) we owe much of the knowledge now spread abroad, are well acquainted with what the attack is and the ease with which it might be got rid of, but with the men who work about the cattle the old stories handed on from generation to generation will remain unless they are driven out by teaching or by showing. We cannot hope to manage this by any other means than what Mr. Stratton well describes as "ding, dinging;" by patient repetition, like blows at the anvil, the matter will be driven into shape, if the leaders will but use their influence, but it should not be forgotten that unavoidable ignorance is one thing, and idleness and deceit another, and that a sweeping statement (where master or buyer knows no better) that the bumps only show a desirable state of affairs is used to hide many a case of sheer neglect and laziness, and to put off many a beast unfairly on an ignorant purchaser.

The great losses both as to health and regarding quality and quantity of milk in dairy farming, loss of flesh on fattening beasts, and deaths from what is shortly termed "rotteness" of the back, and other consequences where Warble holes are many, and the losses on hide, have been gone into in such detail in my preceding reports, it is unnecessary to repeat them, but I give a few notes from the communications of the last season which confirm the previous information, and especially continue to prove the ease with which the attack may be put an end to.

The notes following refer to illness, inflammation, and general non-thriving, being caused by Warble presence.

"Last year about this time, I was called in to a little three-year old heifer whose back was almost covered with Warbles, and the effect on the constitution was very marked; the poor thing was very thin and would not eat. I was satisfied that the irritation set up by the Warbles was the cause, and applied the following :—Turpentine, 1½ oz.;

sulphuric acid, 1 drachm (here a chemical action takes place, and must be done with caution). To this I added 10 ozs. raw linseed oil, and rubbed the cows back once a day with the mixture.*

"In a fortnight the back was cleaned, and all the maggots destroyed."—HENRY THOMPSON, M.R.C.V.S., Aspatria, near Newcastle, April 11, 1887.

"One of the cows I purchased has 18 large Warbles. The skin all along the back appears hot and inflamed. Sores have also broken out in other parts of the body. I applied the smear myself, and found her very irritable when touched."—J. A. SMITH, Rise Hall, Akenham, near Ipswich, March 28, 1887.

"I am thoroughly convinced of the great loss occasioned by these pests. I may say that the young cattle going in summer on the mountain pastures are specially infested with them, and the loss from the cattle not thriving as they ought is very serious."—JAMES MCCONNCHY, Ardnacross, by Campbeltown, Argyleshire.

May 2nd, Mr. John Saunders, writing from Berniehill Farm, Milnathort, Kinross-shire, requested information as to Warble, and how to cure it. "As I had four very fine stots this winter that were very ill with Warbles, I blame nothing else for keeping them down in condition."—I. S.

"I am convinced that the Warble-maggot at this time of the year, when cattle owing to the shortness of keep are in many cases weak, are a great hindrance to their thriving."—EVAN WILLIAMS, Bryndee, Llyswen.

"Local butchers who have killed our cattle that were bad with Warble this spring tell me that their presence involves much greater trouble in skinning and cleaning, but if the cleaning be very carefully done they do not consider that the meat has been injured. . . . I think that the animals killed during April and May, affected with Warbles, brought from ten shillings to one pound less than they would have done if they had been free of this blemish."—DAVID WILSON, Jun. Carbeth, Killearn.

Benefit of clearing the maggots; various applications found to answer for killing them; summer galloping stopped by destroying the maggots in spring.

In the following notes it will be observed that several kinds of applications have proved serviceable. The point wanted is, that whatever is put on should either stifle the maggot by choking up the breathing-holes, which are placed in the little black spots at the tail

* "The sulphuric acid, turpentine, and raw linseed oil mixture is an old preparation, very old, and is known by the name of Black oils."—H. T.

of the maggot, seen in the opening of the Warble, or should poison it by the application oozing down to the bottom of the Warble cell. As the maggot lies with the end through which it draws in food downwards, whatever of a poisonous nature that runs down mixes with the fluid or putrid matter, and is necessarily swallowed by the grub.

Of the various applications which are reported, and have been reported for several years, as serviceable for killing the maggots, it appears to me that mercurial ointment is the best adapted to the purpose in hand, as it *both* chokes and poisons the maggots; but it should never be used except as a very small spot placed just on the tail of the maggot in the Warble. It should *never* be used as a smear, nor should the touching be repeated except under special circumstances, or to (say) two or three Warble holes, and it should only be applied by those who can be trusted. Of the other remedies, McDougall's smear has been the most reported as almost unfailing in effect, and squeezing out needs no comment. Where the *animal* can bear it, the *operator*, especially if he is a boy, has such a satisfaction in the demonstrably successful operation that this method needs no recommendation. The use of Calvert's carbolic soap, tar, brimstone, and various other applications will be found mentioned below, to which I will add cart-grease, or bad butter, or lard mixed with sulphur, which has been found to be an extremely good application.

Benefit from destroying Warble-maggots.

"I think I told you that the herd as far as they have been reared on this farm, where I have prevented the grubs from developing into flies, is quite free from Warble."—March 28th. . . . "In exterminating the Warbles on purchased cows in June I used the 'Smear,' also Bowden's Hippacæ, (Indian preparation), and also salt and water. The former two were effectual, but the salt and water appeared useless and difficult to apply in the holes caused by the Warbles. I am now using McDougall's dressing, as a wash to keep all flies off my cows, with good effect."—J. A. SMITH, Hon. Secretary, East Suffolk Chamber of Agriculture.

"On our own farm we have strictly followed the directions, and killed every maggot, and also smeared the backs of the cattle, with most beneficial results. In our stock, which formerly used, (as the men say) to *boil* with these maggots, not one is to be found now, but nearly every beast we buy has them."—The Hon. CECIL PARKER, Eaton Estate Office, Eccleston, Cheshire.

"This pest, I am very sorry to say, is very prevalent in this neighbourhood. I do my best by the application of mercurial ointment to keep them down in my own herd, but as my neighbours do

nothing the pests always appear with the spring."—R. BASSETT, Highclere, Newbury.

"We have a large dairy, and last year found a great number of maggots. We used mercurial ointment as you advised, and got out a great number."—Miss MARGARET CURTIS HAYWARD, Quedgeley, near Gloucester.

"I have sixty bullocks now fattening in covered yards. I believe that every one has Warbles more or less. I have had them dressed with mercurial ointment, and I believe all the grubs are killed."—K. M. COURTAULD, Cut Hedges, Halstead, Essex.

"We have not examined all the stock , but as far as I have been able to examine the cattle I have not found one [Warble]. We used powdered brimstone as being least likely to taint the milk."—DAVID BYRD, Bnnbury Heath, Tarporley, Cheshire, April 2, 1887.

"Our twenty-five cows are at present free from Warbles, thanks to your exertions. Last two winters we put a spot of tar on each opening,—but of course our neighbours grow plenty,—and I think the immunity is due to washing the backs of the animals, last summer several times with tar-water."—J. A. CHAPMAN, M.D., Bury Hill, Hereford, March 28, 1887.

"From another tenant I elicited that living in an isolated farm, where there was no sale for buttermilk (or 'churn' milk, as we northerners term it), he used the same as a wash for his cattle three or four times in the season, which kept them remarkably free from the pest; and another treats his stock with strong brine, and with similar results."—F. C. SMITH, Westgate Road, Newcastle-on-Tyne.

Good effect of dressings, and also of previous removal of the maggot, in preventing summer disturbance.

"I should have written you before as to the effect of dressing for fly, but thought I would wait and make quite sure as to the results. I prepared mixture as you recommended, *id est*, 4 oz. flower of sulphur, 1 gill spirits of tar, and 1 quart of train-oil, and applied the same to 16 beasts. The effect was very marked; previously they had been galloping about all the day, continually getting out of the field and giving much trouble thereby, since not one of them has got out, and the men who were making hay in adjoining fields, and had full opportunity of watching them, tell me that *since being dressed they have scarcely run about all*. I have since applied the same mixture to the whole of the beasts on my farm, and am so well satisfied with this application that I have not tried either of the other receipts."—H. J. HILLARD, Helland, North Curry, Taunton.

"At the beginning of the spring of 1886 I saw a note in one of our local papers from you, calling the attention of owners of cattle

to the Warble-fly. I set about to dress them with mercurial ointment, and it had the desired effect; they were very little disturbed all the summer, but it was more noticeable at the beginning of this year to see how clean and nice the backs of the cattle were, only two or three that had any upon them. The young cattle, (I mean the one year old and two years old) were not dressed, as I did not consider they needed it, mostly being only one year old this spring. I found several of them had a good many. I have dressed all or nearly all a second time to-day. I am glad to say my cattle have to my knowledge only once been disturbed through this very hot weather. I have dressed this year with sulphur and train-oil, which I see you recommended."—W. DAVIDSON, Lower Green, Acton, Northwich.

"We followed the directions given with the most satisfactory results. During all the trying weather of the past month our cattle have been quite comfortable and comparatively free from insects of all kinds, forming a happy contrast to their condition in previous summers."—Mrs. HIGGS, Westons Rusper, near Horsham.

"For many years I have used a weak solution of McDougall's sheep-dip, and have found it keep my grazing cattle perfectly quiet in the hottest day. We drive the cattle to a corner and keep them jammed close together by the dog, whilst the man sprinkles them with a common garden watering-pot with a rose on the spout. This is done every week, if the weather is wet, otherwise about every ten days."—H. LINDSAY CARNEGIE, Kinblethmont, Arbroath, Nov. 18.

Mrs. Holford, wrote from Castle Hill, Berne, Dorchester:—"I have found well washing my cattle in the spring with Calvert's carbolic soap, kills all the maggots; we wash them thrice at a fortnight's interval. Carefully following your directions as to dressing for the fly has given our cattle a quiet summer."

Capture of the Warble Fly amongst tethered cattle.

The Warble-fly itself is seldom captured, but I was fortunate enough last summer to have two specimens sent to me by Mr. W. S. Richards, of Rathturret, Warrenpoint, Co. Down, Ireland. The first was forwarded on the 80th of June, with the observation:—"It seems that when the cattle hear it in the air they are off. It does not seem to do more than rest on the cattle for less than a second. My cows are docile; I can stand near them and watch. Bees of different kinds they took no notice of, but knew the hum of this insect." On the 17th of August Mr. Richards sent me the second very beautiful specimen, which was quite soft and uninjured when I received it. From the downy appearance the insect looked exceedingly like a good-sized bee (only with one instead of two pairs of wings), and the black band across the body between the wings, with a yellowish band before

it, also the blackish band across the abdomen, and orange colour at the tip showed well. Mr. Richards wrote accompanying, after alluding to my previous letter on Ox Warble Fly. "We have been since trying to catch some more, and, though we had several chases, only were able to get one this morning. . . . This one flew at the legs and flanks of a young Guernsey bull, "he broke tether and came home, the fly still at him; we got them both." . . . "I have never known the flies later than the 2nd or 8rd of August in other years; all my cattle are on tethers, and house-fed by day in hot weather, excepting six before mentioned, (referred to in Mr. Richards letter) which I had no room for and could not then sell. This causes us to watch dates very closely."

The above note is of special interest in connection with the remark of Mr. W. H. Liddell, given in 8th Report, p. 106. "*And why are bulls so very subject to them?* Because they are often fastened, and have no means of clearing themselves of the fly when grazing, and in winter tied up without any attention paid to the state of the backs." It is worth remark, that where the cattle were from necessary circumstances more exposed to attack, the fly was so much more noticeable as to allow having several chases and two captures, and also that the few cattle that were free were so maddened by the fly as to leap a parapet wall for the purpose of getting into water, and continued swimming about in a reservoir nine feet deep, with their own good will, to avoid attack.

The following account is well worth study, as showing what can be done by quiet, unobtrusive, but thorough work in clearing out Warbles from a district. Mr. W. Bailey, the Head Master of Aldersey Grammar School, Tarporley, Cheshire, has now for several years instructed such of his pupils as were desirous to learn in the history, and best methods of destruction of the common farm insects, with such great success that the Consulting Entomologist of the Dominion of Canada, wrote over to enquire into the method pursued. The pupils are for the most part sons of farmers and farm labourers, and the instruction is voluntary. Mr. Bailey gives his exceedingly serviceable teaching, and such boys as desire may have the benefit of it, and we (I may say as I have the pleasure of co-operating to some small extent) have *no examinations*. The knowledge received is shown by results seen on their fathers' farms, and not merely heard by word in examination. With regard to the Warbles the boys were first shown the maggots and told their history, and desired to bring what they could find, and in 1885 one pupil, Frank Ravenscroft, brought 250, and in 1886, the following year, when he examined 114 head of stock belonging to his father and brother, *he found no Warbles*, excepting on the young stock, which had not been dressed, because they were out in the fields.

The work progressed very favourably, and on March 28th of last year Mr. Bailey wrote me that he had desired some of his pupils to examine their cattle, and report results, and he forwarded the following table.

In nearly all the cases in which Warbles were found, including the entry of 50 Warbles on 20 cows, the Warbles were on stock recently bought in, not on cattle which had been examined.

I give the list as sent, with the names of the boys, as they have done good work, and kept it up, and it may encourage others. It will be seen the stock vary in number, from one cow of a cottager, up to the farmer's large herd of fifty-seven.

Aldersey Grammar School, Bunbury, Tarporley, Cheshire.

OX WARBLER.

NAME.	STOCK EXAMINED.	NUMBER OF WARBLER FOUND.
Percy Willis	20 cows & 20 yearling calves	8 warbles in cow lately bought
Edgar Willis	40 cows & 8 heifers	Only 2 warbles
Charles Palin	24 cows & 1 bull	1 warble in bull and 1 in cow
Alick Dale	57 cows	17 warbles in newly bought cows, none in last yrs. stock
John Whittle	42 cows	7 warbles in cow bought, none in others
Thomas Willis	1 cow	1 warble
Joseph E. Dutton	2 cows and 2 calves	None
Herbert Stockton	1 heifer and 1 cow	4 warbles in heifer
James Williamson	2 cows	None
Thomas Whittle	6 cows and 2 heifers	10 warbles in heifer
William Cookson	1 cow and 1 heifer	None
Thomas Jones	20 cows	50 warbles, 20 in 1 cow, remainder in 5 cows
John Kirkham	8 cows and 1 heifer	None
Joseph Proctor	4 cows, 1 heifer and 1 calf	1 warble in calf
George Garnett	10 cows and 2 bulls	8 warbles in one bull
Henry Garner	2 cows and 1 heifer	4 warbles, 8 in cow and 1 in heifer
Thomas E. Willis	10 cows	None
Arthur Jones	2 cows	None
Herbert Mitchell	10 cows	None

Number of Stock examined,
298

Number of Warbles found,
104

March 28th, 1887.

WM. BAILEY,
Head Master.

On April 18th, 1887, Mr. Bailey further informed me :—" Another lot of boys have examined and reported to me on 250 head of stock. The results agree with those I sent you."

" Where the cattle were properly attended to last year by the Warble maggots being squeezed out, or dressed with McDougall's smear or cart-grease, there are scarcely any maggots to be seen now ; where, however, this precaution has not been taken, the enemy is to be found in full force.

" As examples of the former I may mention two of our boys, Henry Milling and Percy Attwood, who paid great attention to the stock in this matter last year.

" Last week Milling examined 48 cows and 10 heifers, and *found only one Warble* ; Attwood examined 58 cows and heifers, and *found only six*.

" On the other side, where remedies had not been applied, "two brothers removed 40 maggots this week from one stock, and their task is not half done ; another boy applied McDougall's smear to 70 Warble-maggots.

" It is not only on our large farms where so much energy is being shown in an effort to stamp out this pest, but the sons of our cottagers are equally active in the cause. These boys in a few years will be our agricultural labourers, and I encourage them to examine and report to me on their one cow and heifer.

" The boys in the lower part of the school are doing what they can. On Thursday, one little fellow only ten years old brought me eight maggots which he had squeezed out of the calves.

" Where the stock is free from the pest the boys tell me, " the cows are milking unusually well this year." . . . " *I have no hesitation in saying that in this parish alone what has been done at your suggestion has put many pounds into our farmers' pockets, for their stocks are giving more milk, and are feeding better. The hides also are worth more money.*"

I have given the above at length as the work being done under the eyes of Mr. Bailey, and likewise of Mr. D. Byrd, of Bunbury Heath, and many of the other farmers of the neighbourhood, it is no mere fancy or half-proved experiment, but what could be judged of by all connected with the stock in the district, and it shows not only the benefit of getting rid of Warble-grubs, and the thoroughness with which they can be cleared out of a district, but the benefit of plain common sense instruction on the subject of farm insect pests.

The last year's work has done much towards undermining the hold of this pest, and I therefore add the chief part of my four-page leaflet (6th edition). which was distributed largely last year. (Should any interested in the subject desire copies for themselves, or for distribution in the coming season, I would forward with pleasure on application) :—

NOTES on OX WARBLE FLY or BOT FLY
(*Hypoderma Bovis*, De Geer.)



1, OX WARBLE FLY; 2, maggot; 3, chrysalis.

THE OX WARBLE FLY, or BOT FLY, is a two-winged fly, upwards of half an inch in length, so banded and marked with differently coloured hair as to be not unlike a Humble Bee. The face is yellowish; the body between the wings yellowish before and black behind: and the abdomen whitish at the base, black in the middle, and orange at the tip. The head is large; the wings brown; and the legs black or pitchy, with lighter feet.

The female is furnished with a long egg-laying tube; but whether she inserts her eggs into the hide or lays them on it has not been made out with certainty.

Egg-laying takes place *during the summer*; it may begin in the month of May, but the time varies with the weather, and with the cattle being on low land or hill pastures, and other circumstances. The egg is oval and white, with a small brownish lump at one end.

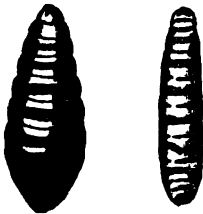
When full grown the Warble-maggot is the shape figured above.

The mischief may first be found on the flesh side of the hide early in the winter. Specimens received from Messrs. Hatton, Hereford, on November 18th, showed the first appearance as small swellings bluish in colour, as if half a large shot was under the skin, and much inflamed round. The maggots were very minute and blood colour, and lying free (not in a cell) with a fine channel down through the hide to where they lay.

The open Warble was first found towards the end of January, and by the end of February open Warbles were noticeable in many places, and the maggot was now white (not being feeding in bloody matter), worm-like, and with strong mouth-forks; in its next stage it was club-shaped, and had a power of inflating itself by drawing in fluid until

it was almost as hard and transparent as ice, and, lying small end uppermost, thus kept pressing the opening through the hide larger. In its next stage it gained its well-known shape, with a thicker and more prickly skin, the Warble cell at the same time gaining its membranous coating.

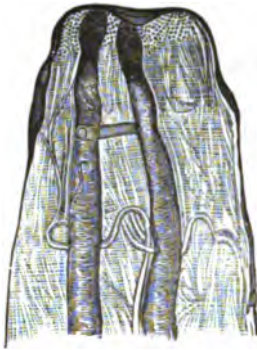
The maggot can move up and down, but commonly has its brownish-tipped tail at the opening, and it draws in air



Maggots.
Club-shaped. Worm-like.
Magnified.



Mouth-forks of young maggot,
much magnified.



Breathing-tubes of maggot,
magnified.

through breathing-pores in these brown-black tips or spiracles. The mouth-end is down below feeding in the ulcerated matter caused by irritation from perpetual suction of the mouth parts. The maggot cannot protect itself from the effect of applications, therefore anything put on the opening where the breathing tips show will choke the breathing apparatus, or run down into the hole and poison the maggot. The earlier this is done in the season the better it will be for the animal, and the less difficulty there will be in the Warble holes healing.

Whilst the maggots are in the Warbles, though a skin-like membrane forms round the surface of the perforations (see figure below), they cannot heal up because the maggot lies within, and when the warble-grub has *fallen out*, though the whole contracts, the surfaces being already covered with a film of tissue are slow to unite; and, as may be seen in warbled hides, union is often prevented by this skin-like film shelling off, and laying with dried matter in the perforation. On the under side of the hide, though the *surface may*

not be broken, yet the subcutaneous tissues are often left as a mere film of no strength, which injures the surface of the leather.

When the maggot is full grown it is about an inch long and dark grey; it presses itself out of the opening *tail foremost* and falls to the ground, where it finds some shelter, either in the ground or under a stone or clod, where it changes to a chrysalis. The chrysalis is dark brown or black, much like the maggot in shape, only flatter on one side; and from this brown husk the Warble Fly comes out in three or four weeks, but this length of time is *increased by cold weather*.

With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the Warble-maggot easily and cheaply, when the Warble has "*ripened*," that is, opened so far that the black end of the tail is visible. *Then* it may be destroyed cheaply and quickly. From special observations, taken during the last two years, it has been found that where the Warble-maggots have been destroyed before they drop from the cattle there is little if any summer attack of Warble-flies. Consequently the cattle can rest in peace, and, as there is very little egg-laying on them, there are scarcely any Warbles in the following spring.

Squeezing out the maggots is a sure method of getting rid of them, but they may be destroyed easily and without risk by dressing the



Section of Warble, after
soaking in water.

Warble with a little McDougall's smear or dip, or by a little cart-grease and sulphur, applied well on the opening of the Warble. Mercurial ointment answers, if carefully used, that is, in very small quantity, and only applied *once* as a *small* touch on the Warble; but where there is any risk of careless application it should not be used. Any thick greasy matter that will choke the breathing-pores of the maggot, or poison it by running down into the cell in which it lies and feeds, will answer well; and lard or rancid butter mixed with a little sulphur has also been found to answer. Tar answers if carefully placed, so as to be absolutely on the hole into the Warble. Bought cattle are often badly infested, and need attention.

To prevent fly attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce.

A mixture of spirit of tar, linseed oil, sulphur, and carbolic acid, has also been found useful, and anything of a tarry nature is useful, as sheep salve (or bad butter and tar mixed with sulphur), or Stockholm or green tar rubbed on the top of the cows' backs between the top of the shoulder-blade and loins. Washes of a strong pickling brine applied two or three times during the season are very useful. Paraffin and kerosine are useful for a time, but the smell goes off before very long.

Warble attack is one of the few in which each owner benefits surely by his own work.

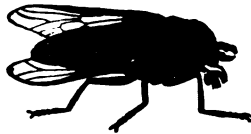
The attack of Warbles is now grown to be one causing enormous annual national loss, estimated by practical men at sums from *two millions to seven millions pounds sterling per annum*, at the least, and there is no sort of reason why we should suffer it to go on. Any applications to myself on the subject will receive immediate and most careful attention, and any information would be gladly received.

ELEANOR A. ORMEROD,

*Consulting Entomologist
to the Royal Agricultural Society.*

Horse Warble.

Various notes have again been sent of observation of Warble in horses, showing that the attack is not uncommon, and is also apt to be very troublesome when the swelling is under the saddle. No advance, however, has been made towards finding whether the fly that causes the mischief is the Ox Warble Fly (the *Hypoderma bovis*) or another species. It has not therefore appeared worth while merely to give notes of observation. The remedies are the same as with Ox Warble.

Ox Gad Fly. *Tabanus bovinus*, L.

TABANUS BOVINUS.

Ox GAD FLY, with side view showing proboscis.

The attack of the great Ox Gad Fly, the *Tabanus bovinus*, is often confused (by name at least) with that of the Ox Warble Fly, and though this Gad Fly is not common with us as it is on the Continent of Europe, during the last season I received some small amount of communication regarding it from various quarters.

This "Gad Fly," which is figured above, may be very easily known from the Ox Warble Fly, by being a great deal larger. It (the Gad Fly) is little less than an inch in the length of its body, and from about, or over, an inch and a half to two inches in the spread of the wings. One of my own specimens is of quite the largest measurement mentioned above.

The fly is mostly brown, and bees'-wax colour. The part of the face beneath the great eyes is yellowish; the upper part of the body between the two wings is brown more or less striped with greyish or yellowish hairs, and the abdomen is very handsomely banded across, with alternate brown and somewhat tawny yellow, the yellowish bands being on the hinder borders of the segments, whilst down the middle of the back—that is down the centre of the abdomen—runs a row of triangular white spots. The under side of the insect is chiefly yellowish or yellowish grey. The legs are dark tawny, or brown with yellow shanks, and the two wings are pale grey, with tawny colour at the base and along the fore edge.

The rich dark colouring and the great size, make the Ox Gad Fly very easily distinguishable, but the chief peculiarity is in the form of

the mouth parts of the female, which are especially adapted for blood-sucking. By the means of the sharp knife or lancet-like apparatus enclosed in the proboscis, the female can pierce into the hide of the animal and suck the blood; and this apparatus, which is very plainly to be seen, is another distinction between this Gad Fly and the Ox Warble Fly, which has nothing that can be called a feeding mouth.

This Gad Fly is not, as far as I am aware, at all common in England, but now and then an enquiry or a specimen is sent, and last year one was forwarded to me on the 26th August, by Mr. James Carter, of Burton House, Masham, Yorks., with the observation that this large insect was occasionally found in the neighbourhood.

I had also a note regarding Gad Fly from Miss Fleming, Monasterevan, Co. Kildare, Ireland, describing the buzz of this great fly, a kind of heavy droning intense noise, easily known when it has once been heard. This loud hum is mentioned by various writers as terrifying to cattle.

The maggot, which is not unlike that of Daddy Longlegs, lives in the earth (*not* in the hides of cattle). It is somewhat cylindrical in shape, smallest at the extremities, or more especially in front, greyish white in colour, and somewhat darker at the divisions of the segments; legless; and has a shining brown elongated head, furnished with two strong jaws or curved hooks, and has a fleshy protuberance at the end of the tail. The grubs are stated to be found in meadow land, and more especially in wood land.

"Their development and pupation take place similarly to that of the Daddy Longlegs."*

The pupa or chrysalis is long and somewhat cylindrical, with six spines at the end of the tail; but as description does not very well convey a precise idea of the appearance of different states of insects, I add a figure of an American kind of Gad Fly, in its three stages, by Prof. Riley, who kindly allows me to make use of it.

The life history of this genus of flies (the *Tabani*) has not as far as I am aware been yet recorded from observations made in Britain, but it is given by Dr. J. R. Schiner, as follows, in Germany:—

"The grubs live in damp earth or sand, or under decaying leaves and stems in damp places.

"The flies are often to be found in cattle pastures, and by roads and paths, where they rest on the stems of trees, waiting for the

* I have not had any opportunity myself of seeing these flies in their maggot or chrysalis state, therefore I give the description of the maggot mainly from the well-known observations of De Geer, and regarding habits mainly from comparison of information given in 'Fauna Austriaca,' 'Die Fliegen,' J. R. Schiner, 'Praktische Insekten Kunde,' E. L. Taschenberg, and 'Intro. to Classification of Insects,' J. O. Westwood.

cattle or horses, to which the blood-sucking females are very troublesome. The male flies frequent flowers, or hover over roads, especially in the morning and evening."*



TABANUS ATRATUS, FAB.

Black American Gad Fly, maggot, and chrysalis, after Riley.

Should these flies be troublesome it would seem—looking at their great size, which makes them very conspicuous; and their loud hum, which draws attention to their presence; and also considering their habit of circling round the animal before striking for blood-sucking—that an active boy might secure the fly with a common long-handled insect net when on the wing, or with finger and thumb on the animal; but I have mainly mentioned this attack to show how completely different the Ox Gad Fly is in size and appearance, in condition in every state, and in habit, from the excessively injurious cattte pest the Ox Warble Fly.

* See 'Die Fliegen,' by J. R. Schiner, previously quoted.

S H E E P.

Maggot of Sheep Nostril Fly. *Cestrus ovis*, Linn.



Cestrus ovis.

Fly, magnified, with line showing natural length, maggots, mouth-hooks of maggot, and tail segment, showing spiracles, and lobes acting as organs of progression, all magnified, after Brauer, see p. 125.

For some years back I have from time to time received specimens of Sheeps' Nostril-maggots, with various enquiries regarding them, and occasionally a statement that the maggots forwarded were found "in the brain," or "at the base of the brain," as the case might be. This circumstance seemed very unlikely, nevertheless it appeared worth investigating, as I was personally aware that in a locality near London the usual buyers of Sheeps' heads did not like to purchase them about May, because of the presence of the maggots (which were certainly there), and which I was informed they considered were in the brain; also the presence of these maggots in the brain has been mentioned in more than one entomological work, and was alluded to by Prof. Riley as being considered possible, according to the evidence of some practical Sheepmen, by means of these larvæ making their way through the perforations of the ethmoid bone; of course in this case the creature would not get in when it was a thick lumpy maggot, about an inch long, but (that is if it did it at all) in its first stage, answering to the fine worm-like form in which the Ox Warble-maggot cuts and pierces its way down through the thick hide of the attacked cattle, to the under or fleshy side.

During last summer I bestowed the best attention I could in examination of Sheeps' heads affected by staggers or "gid," conjectured to be caused by Nostril-maggot, and also of the state of those with maggot in the nostrils, and can certainly say that there did not seem the slightest reason to suppose that the maggots entered the brain, or had anything to do with attack of "gid," of which the common cause is well known; but at the same time there is no reason why a sheep should not suffer, both from hydatid in the brain causing the gid, and presence of the maggot in the nostrils, at one and the

same period, and when a number of maggots, up to over an inch in length, have forced themselves not only into the nostrils, but as far as they can go into the cavities above, the symptoms of discomfort or serious suffering in the front of the head may very likely agree in some respects with those of gid.

The method of attack of the Nostril-maggot Fly consists in laying her eggs, or living maggots as the case may be, in (or by the opening of) the nostrils of the sheep.

These maggots work their way up the nostrils by means of a pair of hooks with which they are furnished, which are placed near the mouth opening, and also (I should say from watching their method of progression) by help of a pair of tubercles placed at the tail with which they can push themselves forward, as well as by the adhesion of the under side of the maggot to the coating of the nostrils. The maggots grow to be from rather under to rather over an inch in length, and of the thick somewhat oval shape figured (p. 121), and white when young, afterwards with dark or yellowish cross-bands. The brown breathing pores or spiracles, like those of the Ox Warble grub, are at the end of the tail, but are somewhat differently shaped.

The maggots feed in the nostrils, or high up in the frontal cavities, and are especially to be noticed about May or June. They are said to feed in the nostrils for a year; when full-fed they fall out of the nose, or may sometimes be sneezed out, and make their way into the surface of the ground in a short time (considered to be from twenty-four hours to two or three days), where they turn to a brown chrysalis, from which the fly comes out in about six or eight weeks.

This two-winged fly (figured magnified) is mottled light and dark over the back, and the precise shades of tint variously described by various writers. From comparison of my own with descriptions I should say that it might be called spotted or mottled with ash grey and black between the wings, and the abdomen also spotted with black and yellowish white, with a silvery lustre when alive; wings colourless and transparent; legs yellowish brown.

Amongst the heads which were sent me for examination, and carefully opened, we found some of sheep which had been ill of the staggers, or what was thought bad attack of "giddiness," had the cyst in the brain, of which the following figure, copied from one given by Dr. Cobbold in his 'Internal Parasites of our Domesticated Animals,' gives an idea; but we could not find any trace of maggot presence either in the brain or nostrils of these, and where I found maggots they were quite in the part of the nostrils or passages external to the brain.

The various specimens of maggots sent me afforded excellent opportunity for investigations of structure, and showed this to be

thoroughly suited both for progression up the nostrils and hanging on to the coating, and also for keeping their breathing-pores safe from being choked by moisture, but by no means suited for living in the brain.



Upper surface of the brain showing an hydatid.*

The form and very special apparatus of the head and tail are adapted for movement and for holding on,—*not for lying in a surrounding soft substance*. Likewise the maggot possesses a breathing apparatus of spiracles so placed at the end of the tail that under special circumstances, and at the will of the maggot, these spiracles may be protected by the upper rim of the end segment in which they are placed being drawn down over them, so as to meet the projecting lobe below, and thus by closing over them (much like the lips over the teeth) preserve these breathing-pores from being choked up by any special flow of fluid matter down the nose. This apparatus has an obvious use in the nostrils, but in the brain the maggot would be so closed in by surrounding matter that the air would have no access to the breathing apparatus whether open or shut. As these maggots live in maggot state for about a year,—and (*supposing them to live in the brain at all*) almost the whole of their year's life would have to be passed in it, because they *could* only pass in whilst still in most

* For the history of the *Cœnurus cerebralis* or Hydatid, which in its young state causes "gid" in sheep, and subsequently develops to tapeworm in the bowels of the dog, in cases where the dog has fed on the uncooked infested brain, the reader is referred to information given in Chapters vii. and x. of 'The Internal Parasites of our Domesticated Animals,' by Dr. Cobbold, where some very plain and serviceable remarks are added as to the part played by dogs in distributing the eggs of the tapeworm so as to start new attack in the flock. I have also especially to acknowledge the kind assistance given me by Mr. H. Bullock, F.R.C.S., of Spring Grove near Isleworth, in helping me to make a careful examination of the first hydatid infested head, which otherwise I could not have fully studied.

minute condition; it appears that the existence of this breathing apparatus quite disproves their presence in the brain, for in it the breathing-pores would be as thoroughly choked up, and the maggot destroyed, as when in the Ox Warble-maggot the pores are choked with cart-grease or any other thick permanent application.

The following are a few details from examination of Sheep-nostril maggots:—

In some specimens sent me from Maulden, Ampthill, Beds., I found the maggot to be arched above, flattened beneath, increasing in size towards the head end. This head segment was much the smallest of all, and furnished with a pair of thick fleshy antennæ placed above, and on each side of, the notch answering to a mouth. From this a pair of strong black curved mouth-hooks were frequently protruded and withdrawn, whilst I held the maggot in my fingers. These appear to be suited to act not only as hooks to drag with, but also as flat nippers or pincers, to pinch up any soft matter that lay between them, and further, at the base of each of these somewhat sickle like hooks, there was a kind of horny tubercle which would give additional help towards dragging the maggot onward.

Beneath, it was furnished with ten narrow cross bands of prickles, the band nearest the head being the smallest.

The tail segment was rounded with a slightly swollen border, and in the centre of the upper part are the dark brown spiracle plates, or breathing-pores, of a shape which might be called triangular, with the angles very much rounded or five-cornered (see fig.), the two sides of the pair of plates opposite to each other being the longest, and in the centre of each spiracle was a raised brown spot.

Beneath the spiracles at the caudal extremity of the larva was such an enlargement that the lower part of the segment projected markedly, forming a central lobe turning up towards the spiracles and bearing a small patch of prickles, on its upper surface (see fig.). Also it was furnished on each side with a fleshy process or tubercle (see fig., p. 121) apparently very useful in progression.

The power of rapid movement was very remarkable. On placing one of the Nostril maggots on a cloth it moved onwards, at the rate of $8\frac{1}{4}$ inches in the first minute, and $4\frac{1}{4}$ in the second, and when the maggot was placed on the hand the movement could be seen to be helped both by head and tail. The black mouth-hooks were almost fixed into the skin of the hand, pressed so firmly that the pressure could be felt, and thus served as a power by which the maggot kept itself in place, whilst the lobe of the tail with its pair of pseudo-feet served to propel the soft body on from the tail end, the maggot thus being able to get on at a fair pace by alternately fixing and shoving. When placed on glass the maggot had a power of moving by simple

adhesion of its own lower surface, to the smooth surface of the glass.

With a view to learn what might happen when the maggots had the opportunity of entering the brain, I placed two on the brain of a recently killed sheep, and watched operations. One maggot gradually disappeared from sight, amongst the folds of the brain; for some time it appeared (when I turned back a fold) to be moist and inflated, but presently died. The other remained outside, and though from the colour of the contents it was obvious it imbibed the blood or coloured fluid in which it was lying, this specimen died also. It was not likely that in any case the maggots should live on putrescent matter, but the above experiment at least showed that when there was every need for them to find congenial shelter, that though one buried itself in the folds of the quite fresh brain, neither of them made entrance into the substance.

It may be thought that entering on the above matter of possible brain presence is quite unnecessary, but from the popular views which are held in some localities, and the doubts which have been expressed, or statements made in various entomological works, it has seemed desirable to endeavour to say something on the subject.

I have little personal knowledge of the attack in its really important aspect as injurious to the flock in the field, and as this comes under regular veterinary treatment need not enter on this part. But it could not fail to be of service when the flies are tormenting the sheep, which may be known by the sheep putting their heads down to the ground, and stamping with their fore-feet as if to drive off the attack, to move them if possible to fresh pastures, where the flies were not coming out of chrysalids from maggots lately dropped from the noses of the sheep, and also to adopt the common practice of tarring near the opening of the nostril, or to use any other possibly more serviceable application, so as to deter the fly from passing in to lay eggs, or to prevent any maggots which may have been deposited alive or hatched out, from crawling into the nostrils and establishing themselves within.

I beg to acknowledge the figures of the fly, &c., of the *Æstrus ovis*, L., at p. 125, as being copied from the beautiful illustrations given by Dr. Friedrich Brauer in Plates III. and VII. of his 'Monographie der *Æstriden*.'

“MURRAIN WORM.”

Caterpillar of *Charocampa Elpenor*, Westwood.



ELEPHANT HAWK MOTH AND CATERPILLAR.*

The caterpillar of the Elephant Hawk Moth, which is figured above, is by no means given as an injurious insect, as its food is of Willow Herb and Ladies' Bedstraw, or on Vine, if the caterpillar chances to be in a garden. But from its extraordinary and repulsive appearance it is often looked on with alarm, and at least in one district in Ireland as the cause of murrain in cattle, and therefore deserves a note to mention its harmlessness.

In the course of last year Miss Fleming, writing from Derry Lea, Monasterevan, Co. Kildare, Ireland, mentioned:—"There is a very large caterpillar sometimes found here (I have seen it four inches long) which is said by popular voice to give the disease called 'murrain' when licked or swallowed by a cow.

"The people call this creeping thing a Murrain Worm The last I saw was on the approach, travelling as if it was running for its life, about five years ago."

On the 7th of August Miss Fleming forwarded me a specimen of this

* The figure of the caterpillar is taken from one of the three beautiful drawings by the late W. Buckler, given in Plate xxv., vol. ii., of 'Larvæ of British Butterflies and Moths,' published by the Ray Society in 1887.

so-called Murrain Worm, which turned out to be the caterpillar of the Elephant Hawk Moth.

On the 20th of August another specimen of the same kind of caterpillar, which was beginning to spin itself up in a light web, was sent me by Mr. N. Richardson, from the Estate Office, Castle Comer, Co. Kilkenny, Ireland. This had been found in a neighbouring garden. The above figure of the caterpillar gives a very good idea of its strange shape, showing the thick strong appearance tapering rapidly to the small head from the great puffed-out segments into which the head can be withdrawn. The name of *Charocampa* is (as is noticed by Prof. Westwood in his 'British Moths,' vol. i.) derived from two Greek words signifying "hog" and "caterpillar," alluding to the peculiar form, much like a pig's head, of the fore part of the caterpillars. They are found of two colours; one with a ground colour of dull green, with a black-brown freckling of network and blotches, and a spot or blotch on the fourth and fifth segments from the head; the other is brown, marked with blackish network of freckles and variously marked with yellow, besides the eye-like or kidney-like patches on the fourth and fifth segments. Prof. Westwood mentions that the caterpillar is green at first and becomes of the brown, or brown varied with yellow colour, with a dark stripe down the back after the second moult.

Both the specimens sent me were at the brown stage. The caterpillar is stated to spin a cocoon of open net on the surface of the ground, or amongst bits of leaves or odds and ends, in which it turns to a brownish chrysalis marked with black.

The moth has the body between the wings, and abdomen olive-coloured, the first with four pink lines, the latter with three broader stripes running lengthwise; the fore wings olive, with transverse bands of pink; the hind wings of a deeper purplish pink with base and fore-edge of a blackish tint. The mixture of delicate colours intermingled with pure white fringe to the hinder wing, and a white stripe on each side of the body between the fore wings, make the moth as beautiful as the caterpillar is repulsive in appearance. It is rather common, especially in the South of England, and the above short note is only given relatively to the evil effects sometimes, though very wrongly, ascribed to the ugly grub.

APPENDIX.

RUSSIAN STRAW.

In the foregoing report, at pp. 44, 45, in the paper on Hessian Fly, notes are given regarding the watch kept for several months during 1887 on imported straw at various seaports on the eastern coast of England and Scotland, with the result of only finding one *puparium*, or "flaxseed," which was attached to a straw grown in Belgium. Later on, that is during November and December, Mr. Edmund Riley, of the Weir, Hessle, near Hull, who had spent much time and pains on this investigation, had the opportunity of examining straw sent from various parts of Russia as packing material for the large amount of eggs then being imported. No Hessian Fly flaxseeds were found, and it will be noticed from the following details that from the method of treatment of the straw it is very unlikely that infestation can take place from this source, as the straw was found to be cut high, above where the flaxseed usually is; also it was thoroughly bruised to render it soft for proper packing-material for the eggs; and, further, a large proportion was dried on racks in heated chambers, as it is requisite for proper transmission of eggs from long distances that they should be packed in quite dry material.

The knowledge of these points is of practical service, as it will be observed that the large import of eggs necessarily brings much straw with it.

On Nov. 12th (1887) Mr. Edmund Riley wrote me from Hessle, near Hull, that in the Report of Imports into Hull, for the week ending Nov. 5th, it was stated that "there was the largest importation of eggs in one week ever reported, and chiefly from Russian ports. One vessel had 60 tons; another 46 tons; and the 'Cato' had 823 cases, each case containing some thousands." On examination Mr. Riley found the eggs "came in long cases, a pretty thick layer of straw at the top and bottom and a layer of straw between each layer of eggs."

On the 21st of the same month Mr. Riley continued:—"During the week I got several lots of straw from the top of the egg crates, but found they had all been cut off above the second joint. On Saturday I went to one of the large importers (Wood Brothers, High Street, Hull) and I found him, like Mr. Halls, ready to help me in any way, so I had a case from Riga, the eggs taken out, and brought all the straw home with me, and have spent the day examining it." The results of this examination were one straw with a hole in it, one curiously deformed, and some that appeared to have had at some

time some insect within, but no Hessian Fly presence; and Mr. Riley noted regarding the state of the straw, "The straw they are packed in appears to me to have been put through a bruiser to soften it and shorten, so that if there were chrysalids in it they would get crushed." Very large quantities come weekly yet, about 100 tons freightage from Galicia, Southern Russia, and Belgium."

On Nov. 29th, Mr. Riley informed me that the straw, of which he had sent some samples, was that of Rye, and that large quantities of eggs were imported from Bohemia and Silesia, as well as from Galicia: "they are still coming in large quantities, 120 tons a week." At the same date Mr. Riley favoured me with information which Mr. G. Becker, the chief importer of foreign eggs, had been good enough, on Mr. Riley's request, to furnish us with.

Mr. Becker mentioned, relatively to preparation of packing material, that there were important differences between the western and south-western districts of Russia, which do not forward through Riga, and the central, eastern and south-eastern districts, which last send their goods through Riga.

The former, that is, the western and south-western, go to Hamburg either direct through Russia, or through Galicia (Austria), and this traffic, being a very quick one, does not pay any particular attention to the straw if it only appears to be dry.

The other districts, however (the goods having to pass over enormous distances), use every possible caution to have perfectly dry straw, and for that purpose *it is dried in heated rooms in racks.*"

From the above information it may be considered that a portion of the straw accompanying the eggs is necessarily so treated that it is unlikely in the extreme that Hessian Fly infestation can be imported in it, and, further, that where the straw is, firstly, cut so high as in the nature of things to leave the puparia, or flaxseeds, remaining behind on the stubble in the fields; 2ndly, where it is bruised to the extent to which this is done in the samples sent me, so as to make it a soft mass, and no longer firmly connected stems and sheaths; and 3rdly when, as is shewn, the packing straw, whether artificially dried or not, *must be dry*, which is a very unfavourable state for development of Hessian Fly, there does not appear to be much likelihood of transmission. But should it be necessary, it is shewn by the above observations that there is a practicable way of putting an end to all danger of infestation by extending the practice, now carried on to some extent, of drying the straw in heated chambers.

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*H. G. Klee Esq. Office of the State Ins.
of Fruit Pest
Berkeley, Calif.*

complements from the U.S.

COLLEGE OF
AGRICULTURE
Berkeley, Cal.

REPORT OF OBSERVATIONS

OF

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AND

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TWELFTH REPORT.

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S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO, AND CORR. MEMBER OF
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PREFACE.

DURING the past year reports have been forwarded regarding presence of almost all the ordinary crop attacks; but at the same time, excepting locally or here and there, few of these ordinary attacks have been to a serious extent.

With the exception of orchard caterpillars the worst attacks of last season were of unusual kinds, and occurred early in the year. The Corn-ground Beetle maggot at young Wheat plants, and the Beet Carrion Beetle, and its Woodlouse-like grub at Mangolds, have not previously been recorded, as far as I am aware, as injurious crop-pests in England. The Frit Fly maggot to young Oats, and the Wheat-bulb maggot were injurious to a quite unusual extent, and so were Bean-seed Beetles in the more southerly parts of England; and though the Winter Moth and other orchard caterpillars are no unusual troubles, they ravaged the trees in most of the chief fruit-growing counties to an unusually serious extent.

After the heavy midsummer rains serious injury ceased to be reported.

Hessian Fly was noticed at about from six to ten localities (six reports sent with specimens accompanying), and these mainly referring to one field or one farm, instead, as in the previous year, of about a hundred notices (with specimens, or from competent observers) being sent, referring in many cases to districts or large areas. The two common attacks—namely, Sawfly maggot in Wheat-stems, and *Chlorops* at the upper part of Barley—were also not nearly as much present as in the preceding year.

It may be worth notice that, while in 1887 some of the most widespread and injurious attacks were of those to the almost grown or ripening corn-straw, in 1888 some of the worst were to the quite young corn-plants in spring. Conjecturally this is attributable to the hot weather of 1887 being favourable for

insect propagation, and laying a foundation for the attacks which were found at work with the advance of the next year's spring. This would apply also to the unusual amount of orchard caterpillars.

To what extent crop insect-pests, not previously known or little known here, may be establishing themselves is a matter which appears to deserve some observation from agriculturists, and I would wish particularly to draw attention to the new Wheat-flour Moth (see pp. 66—72, and Appendix), and also that in case a *pale sea-green fly maggot* is found feeding in Wheat-stems (see p. 66) it would be desirable at once to report it.

How far some of the extra-British corn-pests may be spread abroad by the use of broken straw, infested grain, &c., screened out of foul corn-imports, is also a subject to which I have ventured to draw attention in the paper (pp. 56—66) headed "Screenings," and I have to express my sincere thanks to the Firms or personal friends who have been good enough to favour me with the information there given.

Warble prevention has advanced much during the last season, and it is still more clearly shown than before that where the maggots are destroyed (as may easily be done) the attack may be for all practical purposes stamped out.

For the statistics of loss on hides I offer my very best thanks to the Societies, Companies, and others who have done me the great favour to give me the returns published in my paper, and, whilst referring the reader to details in the reports (and estimates) quoted, by which he can judge for himself of how the matter stands, I may be permitted to note that in a country such as this it appears an evil crying for removal that the *ignorance of the uneducated* should be allowed to cause, year by year, such a demonstrable loss to the nation.

Besides my debt of thanks acknowledged as above, I have also cordially to express my obligation to Dr. E. L. Taschenberg, of Halle, Germany, for examination of the Corn-ground Beetle attack hitherto unobserved in this country, and to Dr. Jul. Kuhn, Director of the Agricultural Institute of Halle, for replying to my enquiries regarding the new Wheat-flour Moth; likewise to Dr. Fr. Thomas, of Ohrdruf, for drawing my attention to a Gall-mite infesting Red Currants,—a matter that might prove of

considerable importance to bush-fruit growers. To my good friends Dr. de Man, of Middleburg, and Dr. J. Ritzema Bos, of the Royal Agricultural College, Wageningen, Netherlands, I am again, as in previous years, indebted for kind assistance in identification and study of crop Eelworms; and to Dr. de Man more especially for the notes and beautiful figure (see pp. 76—79) of a species previously unobserved as infesting Oats.

To Dr. C. Lindeman, Prof. à l'Académie Agricole, Moscow, I am also much indebted for useful information regarding Hessian Fly; and likewise offer my best thanks to Dr. J. A. Lintner, State Entomologist of New York State, for prompt and full reply regarding a cattle fly (called the "Texan" or Horn Fly) newly observed in the U. S. A., which at the time appeared likely enough to be an additional trouble here.

Amongst unfailing colonial correspondents who by letter or publications aid me greatly, I beg specially to thank Mr. Frazer S. Crawford, Inspector under the Vine and Fruit &c. Protection Act, at Adelaide, S. Australia, and Mr. Albert Molineux, Member of the Royal Agricultural and Horticultural Society of S. Australia; and in England I should also mention the help kindly given me by Mr. R. H. Meade, of Bradford, in confirming my identification of Diptera, and also by Mr. O. E. Janson, London, in identifying species which I had not the opportunity of myself comparing with type specimens.

It is beyond my power duly to reciprocate the valuable donations of entomological books kindly sent me by their writers, especially from Canada and the United States. I can but express my hearty thanks for the valuable gifts, and especially to Prof. Saunders, Director of the Experimental Farm Stations, and to Mr. J. Fletcher, Entomologist of the Dominion of Canada; and likewise to Prof. Riley, Entomologist to the Department of Agriculture of the United States; but I may add that, whilst I always endeavour to forward a copy of my Yearly Report, on publication, to each of those who have kindly contributed and aided me, I should take it as a favour in case it does not reach them if they would let me know, as sometimes I am afraid copies have not been duly received.

I have also gratefully to acknowledge the kindly and important aid constantly given me by the co-operation of the Agricultural Journals, and often by that of the general Press.

With regard to illustrations, I beg to acknowledge with thanks:—

Winter Moth (side view), Figure-of-8 Moth caterpillar, and Mottled Umber Moth caterpillar, from 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg.

Joint-worm and injured Straw, from Report II. of Entomological Society of Ontario.

Also Lackey Moth, Small Ermine Moth, and Vine Weevils (*Otiorhynchi*), from the 'Gardener's Chronicle'; Winter Moth, Mottled Umber Moth, and Figure-of-8 Moth, from Newman's 'British Moths.'

For most of the remainder, excepting such as have been specially drawn for these Reports, I am indebted, as in previous years, to the courtesy of Messrs. Blackie and Son, Glasgow, in permitting me the use of the beautiful figures from Curtis' 'Farm Insects.'

For the full-page figure of *Cephalobus rigidus* I am indebted to the courtesy of Dr. de Man, of Middleburg.

The steady increase of work has made it necessary for me to obtain more aid, and therefore, in addition to the constant assistance which has been rendered me now for many years by my sister, Miss G. E. Ormerod, especially in translation from foreign languages and by entomological work, I have now the additional help, as needed, of a lady amanuensis (Mrs. Hartwell), who acts as my Secretary and general assistant with great service to myself.

In the coming season I trust the friends and contributors by whose information the foundation of my Reports is year by year laid, will continue to favour me with the observations from real live field-work, by which alone information of practical use for counteracting farm pests can be accumulated, and on my side I will promise that, so far as in me lies, I will give my best attention to enquiries sent me, and also, as before, I shall hope to forward a copy of the year's Report when published to the acceptance of those by whose contributions of information it has been mainly formed.

ELEANOR A. ORMEROD,

*Consulting Entomologist of the Royal Agricultural
Society of England.*

TORRINGTON HOUSE, ST. ALBAN'S,
March, 1889.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS.

DURING 1888.

APPLE AND ORCHARD ATTACKS.



CHEIMATOXIA BRUMATA.

Winter Moth; male and wingless females.

During the last season enormous and quite unusual amount of harm has been caused by insect-attack to orchard fruit-trees of various kinds, namely, Apple, Cherry, Nut, and Plum. It is difficult to class these attacks either under the names of the insects or those of the trees, because, on one hand, different kinds of insects have often been injurious at one time to one kind of tree; and, on the other, different kinds of trees have been infested by one kind of insect, as, for instance, by the Winter Moth. I have therefore classed them under the general heading of "Apple and Orchard Attacks," and refer the reader to the index for guidance to special kinds. The inquiry, so far as was reported to myself, with specimens accompanying, was mainly caused by various kinds of moth-caterpillar, and two kinds of small beetles (weevils), of which one kind attacked orchard-leafage, and the other did damage, by means of its maggots, in Apple-buds. In some

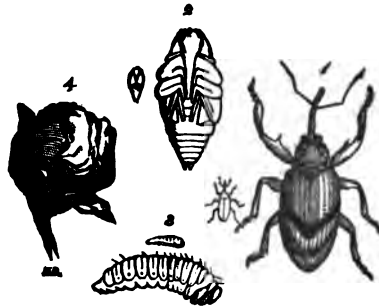
cases, as with regard to two kinds of moth looper-caterpillar, the life-histories are so similar that they fall under similar means of prevention; in two other cases, where the moth-caterpillar lives in companies, one method of lessening amount of attack is applicable (or desirable, so far as it can be carried out), in each case; but, so far as last season's experience shows, the only remedy which at present is usually serviceable when attack is going on, is shaking down the caterpillars, or beetles. This, it will be seen, has been largely practised with satisfactory results.

In arranging the following Report, where I have had distinct notes sent of one kind of insect, and its special method of injury, separately from others, I have given these separately, with the addition, so far as I was able, of a figure, and likewise an account of the habits of the pest. In other cases, where the mischief was caused by several kinds of insects, I have given the reports of damage, and placed the accounts of the insects, of which samples were sent, under their respective names in the following pages.

The notices of attack were (as might be expected) from localities or districts in some of the chief fruit-growing counties, namely, Worcestershire, Gloucestershire, Herefordshire, and Salop, and likewise Kent and Surrey.

The following note refers to Apple-blossom weevil :—

Apple Weevil. *Anthonomus pomorum*, Curtis.



ANTHONOMUS POMORUM.

- 1, Weevil; 2, maggot; 3, chrysalis, magnified and nat. size;
4, Apple-bud, injured by weevil.

Attack of Apple-blossom Weevil was one of those which caused serious loss to fruit-growers during the past season. On the 21st of May specimens of the maggots, well-advanced in growth, were sent me from Newlands, near Sittingbourne, Kent, with a note that the attack was then very prevalent on Apple-trees in East Kent. Mr. Lake, by whom the specimens were sent, mentioned that he was not aware

that it had prevailed to any extent before, but it was then very general in early blossom, and to be found in most trees to a greater or less degree.

The method of life of these small weevils is for the female to make a small hole in an *unopened* flower-bud by means of little jaws placed at the extremity of the long proboscis or snout, with which these "long-nosed weevils" are furnished. The beetle only lays one egg in each bud, so that the process of egg-laying goes on slowly, and may last as long as three weeks; and this point is of some importance practically. She cannot lay until the blossom-buds are formed, and as soon as the blossom-leaves begin to unfold egg-laying ceases.

We cannot alter the weather, but, by keeping the trees in such order as to ensure the greatest amount of sunshine reaching the flowers, rather than allowing an undergrowth of boughs touching the neighbouring trees, and thus giving a long successive time of opening to the flowers even on one tree (precisely suiting the beetles' needs for laying day after day), we cut short part of the beginning of the attack.

The weevil-egg hatches in about a week. The maggot is whitish and legless, and with a black, horny head; it feeds within the blossom-bud, and its presence is shown by the blossom-leaves, instead of opening, turning brown and remaining folded together. The maggot turns to chrysalis in the injured bud, and in about three weeks from the time of hatching of the maggots, the weevils come from the chrysalids, and disperse themselves over the tree. They are said to injure the leafage, but the great mischief they cause is that to the buds.

Prevention and Remedy.

During the winter the weevils shelter in chinks or crannies, or other convenient shelter on the trees, or under clods and stones near it; so that keeping the bark in good order, removing rough broken pieces, smoothing away rough projecting edges where there are deep cracks, cleaning off lichen from the boughs, and other similar plans to get rid of lurking-places on the trees, are measures which are sure to be useful. When it is wished to preserve the fruit of any especially valuable tree from coming attack, it would be a good plan to syringe a strong mixture of soft-soap (with just enough paraffin to give it a scent) on to the trunk and branches. This would lodge in the crannies, and, if done during early spring, just before the Apple-tree shows growth, would probably be very serviceable. Where trees stand in bare ground, stirring the surface and throwing a little quick-lime or gas-lime would be of use; in grass-orchards it is difficult to meet the point of harbourage in the ground, but sticky bands round the trees are of use in keeping the female weevils from creeping up. These *can* fly, but are considered not to do so customarily; so that, if

they are prevented by the above measures from lodging on the tree itself, and are prevented by sticky bands from crawling up the trunk, their attack is fairly kept in check.

Various sticky mixtures may be used. Of these Davidson's composition is perhaps the best; but various mixtures of tar, such as tar and cart-grease, or tar and oil, or tar by itself, would probably serve the purpose. It should, however, always be remembered that if the tar melts in hot sunshine, it may greatly damage the bark of young trees; therefore, it appears more desirable to twist a rough hay-rope or band of some sort, and dip this in the sticky mixture, and lay it close to, but *not touching*, the tree, when the bark is young and delicate. The weevils drop to the ground on being alarmed, so that, when bad attack is feared, it would be worth while to try whether it is really present by smartly jarring the boughs of a tree or two, and seeing whether weevils fall on a large cloth spread below. In case they *are* found, it would not be very expensive to have the trees well-shaken, and thus cleared of many of the pests, as they could not crawl back over wet tar-bands or Davidson's composition.

Green "Leaf" Weevil. *Phyllobius maculicornis*, Germ.

The following observations refer to damage caused near Sittingbourne, and especially to the fruit-trees of Mr. Faunce de Laune at Sharsted Court, by a small green weevil-beetle, scientifically, the *Phyllobius maculicornis* of Germar. These little weevils are only about a quarter of an inch in length, and very similar in shape to the *Otiorhynchus* weevils (see index for reference to figure).* The colour, unless the scales have been rubbed off, is of a bluish, golden yellow, or green tint, the feet and shanks yellowish, and horns of a red tint.

There are many species of *Phyllobius*, and they are remarkable for the great numbers in which some of the kinds appear from time to time on orchard-trees, and the mischief they cause by their attacks on leafage and buds, and also to young grafts.

The following clear observations of the attack were sent me, beginning on May 26th, by Mr. Arthur Rayfield, from Sharsted:—

"I herewith enclose some specimens of a green insect that I have observed on Mr. Faunce de Laune's fruit-trees for three or four years past. They come in larger numbers each succeeding year, besides spreading over a larger area. I notice this spring that they first made their appearance about the 20th of this month. I have succeeded in catching a considerable quantity by shaking the trees (standards), and holding a tarred cloth beneath, on which they fall and stick, until

* The *Phyllobius maculicornis* is about two-thirds of the length of No. 5 of figure referred to.

some fresh tar is put on; but it is impossible to *get rid* of them in this way, as they swarm over several hundred acres, settling on fruit-trees, —Cherries, Plums, Apples, and Nuts,—besides nearly all other kinds of trees and bushes, such as Thorns, Sloes, and even Firs. They appear to live on the leaves of what trees they alight on, but prefer those that have been newly planted. They take advantage of any shelter, and prefer the south side, in the sun, and out of the cold winds."

On June 1st, Mr. Rayfield wrote further that he had succeeded in catching great numbers of the leaf-weevils "but there yet remain huge quantities. We are most successful in catching them in the morning and evening, when it is dull and not too much wind. They collect in larger numbers in sheltered places, but when disturbed by a sudden jar, while the sun is shining brightly, and in a warm temperature, some take to wing, and consequently avoid the tarred cloth held beneath." A few days later—on June 4th—Mr. Rayfield reported that the beetles appeared to be diminishing in number, but, though he searched carefully, he could not make out where the eggs were laid, or the maggots lived.

Very little indeed, as far as I am aware, is known of this stage of life of most of these *Phyllobius* beetles, and we need to know it, to forestall coming attack; but, looking at the fact of the maggots not being reported as found in the buds, and also that one kind of *Phyllobius* passes its maggot-state and changes to chrysalis *in the ground*, I should think it very likely that this species did so too. It is stated (see reference below),* with regard to the *Phyllobius oblongus*, a species which is especially mischievous to Espalier and dwarf trees, and in nurseries, and also to grafts, that towards the end of June the beetles disappear; and "the females lay their eggs in the earth, where the maggots feed on the roots of various meadow-plants, and pass the winter, and appear thence as beetles in the following spring." This matter would be well worth investigating with regard to the Kentish attack, and, by turning up sods in different places under some of the trees that were infested last year, there would be a good chance of finding the maggots. They might be expected to be whitish and legless, with a head furnished with jaws, and in general appearance, although much smaller, very like *Otiorhynchus* maggots.

At present the only remedy for attack of the beetles appears to be shaking them down, taking care (as Mr. Rayfield notices) that this should be done at such times, and in such weather, as will cause the beetles to be in some degree torpid. In warm sunshine, in the middle of the day, the beetles will be very apt to escape; and this point is particularly dwelt on in the German directions for prevention.

* 'Die Pflanzenfeinde,' von J. H. Kaltenbach, p. 180.

THE FOLLOWING OBSERVATIONS REFER TO ATTACKS OF MOTH-CATERPILLAR.

Of these the most important kind, of which samples were sent me, were caterpillars of the Winter Moth (Cheimatobia brumata); the Mottled Umber Moth (Hybernia defoliaria); the Lackey Moth (Clisiocampa neustria); Small Ermine Moths (Yponomeuta padella, and possibly Y. malivorella); and the Figure-of-8 Moth (Diloba cœruleocephala); though several other kinds were present.

The observations immediately following refer chiefly to injury from caterpillars of the Winter Moth, or Evesham Moth, as it is sometimes called in the West of England; and where other kinds were also present, the reader is referred to the full description of these, for which consult Index.

Winter Moth; Evesham Moth. *Cheimatobia brumata*, L.

(Figured p. 1).

Amongst the moth-caterpillars which have done most harm to Apple, as well as other fruit-trees, during the past season, those of the Winter Moth, the *Cheimatobia brumata*, stand first. These caterpillars vary a good deal in colour, and also change in appearance after moulting. When hatched they are greyish, afterwards of a yellowish green, faintly striped with white along the back, and with dark head and mark on the neck. Afterwards the dark colour is thrown off, the green is of a clearer tint, and the white stripes plainer, and after the last moult the caterpillars are of a yellower green, with a light brown shining head. A stripe of darker colour down the back is probably (or, at least, in part) from the food showing through the skin. When full-grown they are about an inch long. For general purposes they may be known by their greenish colour, and also by forming an upright loop when walking. When full-fed they let themselves down by a thread to the ground, and go into chrysalis-state a little below the surface, from which the moths begin to come out about the end of October. The moths are of the size and shape figured at p. 1, and of a greyish colour. The fact of the *female having only abortive wings* is important to be observed, as on this turns the best means of prevention.

With regard to amount of appearance of these serious orchard-pests during the last season, Dr. J. A. Chapman wrote me, on June 18th, from Hereford, as follows:—"This spring the larva of *C. brumata* has been vastly more abundant than usual, doing much damage, especially to Apple-trees, which are in some instances quite defoliated, and the chance of a crop nearly destroyed. The dry winter has been very favourable to this moth, and to others of allied habits. Curiously,

the peculiar cold spring has not retarded it as it has done nearly all other insects (lepidopterous, at least), so that it is now nearly all gone to pupa, whilst many species, usually its contemporaries, are still feeding."

On June 11th, Capt. Corbett (to whom I am also indebted for observations further on), writing from Toddington, Winchcombe, near Cheltenham, reported:—"The Winter Moth has, indeed, been bad here. We caught the moth by thousands, with the band of tar and grease put on in October, and by renewing it lately we have caught numbers of the caterpillars; but for all this the destruction is terrible."

Besides the Winter Moth-caterpillar mentioned above, Capt. Corbett forwarded specimens showing the presence of caterpillars of "Mottled Umber," "Lackey," "Figure of 8," "Small Ermine" moths, and also of one or two other kinds not specially destructive.

Mr. Robert Mercer, writing from Rodmersham House, near Sittingbourne, Kent, on Feb. 10th, mentioned that Apple-trees on his ground had suffered much from caterpillar of the Winter Moth in the previous spring, and added:—"I have followed your advice in using Davidson's composition, and all through the month of November the belt of mixture at the bottom of the trees were almost covered with the moths. I have also used a slight covering of gas-lime on the land."

The following note refers more particularly to Cherry attack.

On June 8th the Rev. J. Ayscough Smith, writing from the Vicarage, Tenbury, Worcestershire, forwarded me some specimens of Cherries,—fruit and leaves,—as samples of insect-injury, of which he had written a short time previously, and further mentioned that in the orchard he had visited, and some adjacent ones, more than half of what ten days previously promised to be an abundant crop was destroyed. In this case some of the specimens proved to be caterpillars of the Winter Moth, and some of a Green-leaf Weevil,—a *Phyllobius*,—apparently *P. maculicornis*, Germar, the same species noticed at p. 4 as doing much mischief in Kent. There were also two kinds of small caterpillars agreeing with the description given by Dr. E. L. Taschenberg of those of the Tortrix Moths, *T. ribesana* and *T. cerasana*, H. The first of these is noted as feeding on many kinds of leafage, both of orchard-trees and bush-fruits, and that it goes into chrysalis in similar places. The second as more especially feeding on buds and young leafage of Plum and Cherry.

The following note, sent me, on June 9th, by Mr. A. K. Hudson, of Wick House, Pershore, Worcestershire, shows the serious amount of attack in the orchards of the Vale of Evesham. In this case the accompanying specimens were of the Winter Moth, and likewise of Lackey Moth caterpillars.* Mr. Hudson wrote as follows:—"The

* For figure and account of Lackey Moth, see p. 10.

accompanying caterpillars are specimens of what has this season taken the form of a very serious blight on our Plum-trees. Many of the trees are entirely stripped of their leaves by these voracious pests, and the trees thus denuded either wither away and die, or else the fruit all drops off. I have forwarded these specimens for your inspection, as you might be able to determine their nature, and give the numerous fruit-growers in this Vale of Evesham (where the culture of the Plum affords a livelihood to many gardeners and labourers) a few hints for the prevention of these pests in the future." On June 15th, Mr. Hudson wrote further :— "The ravages of these insects in this neighbourhood are very partial ; a Plum-orchard may be attacked, and all the trees left leafless, and the next one to it will appear to be quite free." This observation is important, as it points to the attack of some of the kinds of insects being demonstrably so local that it may be presumed that local applications would be useful as preventives.

The same points, namely, very severe injury in some cases to several orchards (or even to one single tree) occurring whilst there was perfect freedom from blight on the trees around, and likewise *the trees themselves* being destroyed, even to the amount of several acres, by the "blight," are reported in the following observations, placed in my hands by Mr. Thos. Hyiatt, of Mickleton, Chipping Campden, Gloucestershire. These refer to insect-blight on thirteen orchards, respectively at Mickleton, and the neighbouring parishes at Aston Subedge, and Quinton. The attack was of green "looper" caterpillar, corresponding, both in appearance and colour, and in habits, with that of the Winter Moth. Of three orchards at Aston Subedge, planted with Cherries, Greengage, Plums, Apples, Pears, Walnuts, &c., Mr. Hyiatt reported that the blossom was a perfect picture, and the Cherries and plums were set before the attack (or "blight," as it is termed) began. The green caterpillar then appeared by thousands, and, after hanging by webs and floating from tree to tree, they made twenty acres as bare as in winter, neither fruit nor leaves remaining, and destroyed three-quarters of the trees in one of the orchards of $7\frac{1}{2}$ acres.

In another orchard, a quarter of a mile from the above, about half the sale was realised of what it ought to have been for the Cherries, and no second sale on account of the "Blenheim Orange" being blighted and fallen off. Two orchards adjacent, that is, about ten yards from the above, were free from blight. At Mickleton (of two orchards) one is noted as appearing burnt up by attack, whilst in the other, one tree only was attacked, and thus defoliated. At Quinton five orchards were reported as more or less blighted, one being, as it were, burnt up.

On June 16th, Mr. James Craig, writing from Weston-under-

Lizard, near Shifnal, Salop, regarding the enormous amount of caterpillar-attack on Oak-leafage, mentioned :—" They are destroying many of the fruit-trees too,—Plums and Apples ; they gather a few leaves round the fruit, and eat it instead of the leaves. They are also on the thorn-hedges ; some of them are quite bare."

Amongst various communications from the other side of the country to the above-named places, a note was sent, on June 1st, from Copal, Dorking, Surrey, by Mr. Goodchild, with moth-caterpillars accompanying, mentioning that they were " specimens of kinds which infest our Apple-trees more especially ; but Pears and Quinces in the orchard also suffer." The most hurtful of the kinds sent in this case also were of Winter Moth (which appears to have been by far the most generally distributed last year), the Mottled Umber, and the Figure of 8 Moth ; and all sent were taken off Apple.

Somewhat earlier, that is, on May 5th, Mr. Thos. Buss had written to me, from Haymans Hill, Horsmonden, Kent, regarding damage to his Apple-orchards from a " looping " caterpillar ; he mentioned :—" Last year several acres of my Apple-orchards (and some Cherries) were severely attacked by ' looping ' caterpillars, which cleared off nearly all the leaves. I find they are come again this year ; some of the small leaves, which have not opened from the bud, have one or two in them." In this case more than one kind of " looper " moth-caterpillar was present, but part of the damage, of which specimens were sent, corresponded with that of the common Winter Moth-caterpillar. This begins its operations by fastening the parts of the leaf or blossom-bud which it infests together, with a web so fine that it is almost invisible, and as time goes on, in extreme cases, the caterpillars fairly clear off all that is eatable, and the brown remains give the tree the appearance of having been scorched.

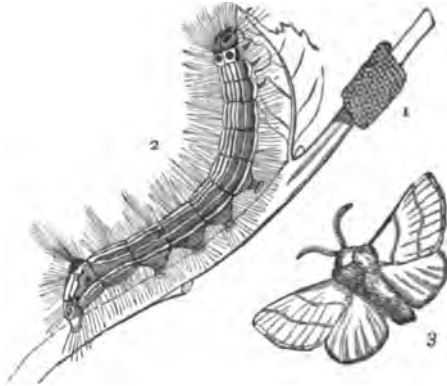
At Bexley Heath, Kent, the Lackey Moth-caterpillars also did harm to the Apple-trees (see Lackey Moth).

On June 8th, Prof. Thos. J. Elliot wrote me, from the Weald of Kent College of Agriculture, Hole Park, Rolvenden, Kent, regarding the needs of one of the staff, who occupies a large fruit-farm, mentioned that this year " there is a plague of small green caterpillars on the leaves of the fruit-bushes, especially the Cob-nut bushes. So thick are these caterpillars, that five bushels a day can be gathered from the leaves. There is great danger of the timber being very much affected."

In many of the cases above-mentioned the great damage was caused by several kinds of caterpillars feeding at the same time on the infested trees. As these are very similar in their method of injury whilst in caterpillar-state, but differ in many points of life-history (such as place or method of deposit of eggs, duration of chrysalis-state, or

locality in which this state is passed, and other points bearing on means of prevention), I have given the histories and also figures of some of the most important of those, of which specimens were sent me, in the following pages.

Lackey Moth. *Clisiocampa neustria*, Curtis.



CLISIOCAMPA NEUSTRIA.

1, cluster of eggs; 2, caterpillar; 3, moth.

The Lackey Moth-caterpillars have been one of the kinds most especially destructive in the last season. These are very easily known. They are about an inch and a half long when full grown, hairy, and partly of bluish-grey colour, striped with black, scarlet, blue, and white. They may be generally described as spotted with black on, and near, the head; on the rest of the body they are ornamented with a white stripe along the middle of the back, and three orange or red stripes along each side, between the two lowest of which on each side there is a blue stripe; these gaily-coloured markings being divided by lines of black, or black spotted with blue. They feed on various kinds of trees, but are especially injurious to Apple-leafage. The eggs are laid in the preceding year to that in which the attack takes place, and they may be found in winter and spring arranged in a compact mass, or rather ring-like band on the wings, exactly as figured above. The caterpillars come out from these about May, and at first are black. They live in companies of as many as fifty to two hundred, and spin a joint web, under the shelter of which they live in bad weather, or at night, and go out from their web-tent (which is enlarged as may be needed) to feed. When full-grown, which is about the middle of the summer, they scatter themselves separately, and *do not go down into the ground* to turn to chrysalids, but spin cocoons anywhere in reach of their food-trees, as on leaves, or in

hedges, under bars of railings, roofs, or anywhere, in fact, that they find convenient. These cocoons are of silky web, powdered with yellow or white dust, and from the brown chrysalis in this cocoon the moth comes out towards the latter part of summer.

The figure (p. 10) shows the shape and size of the Lackey Moth. The colouring is excessively variable, but the fore wings may be described as of some shade of rusty-fox, yellowish, or dark brown tint, with two transverse bars, these being sometimes of a pale tint on a darkish ground, or sometimes, on the contrary, the ground colour is the paler, and the bars dark; and in one specimen before me there is a transverse band between the two bars, of a deeper colour than that of the rest of the wings. The hinder wings are also of some tint of brownish colour.

The best remedies for this attack are clearing off the webs *with the caterpillars within them*, or jarring the boughs so as to make the caterpillars fall to the ground. In the latter case some may escape, as they let themselves down by their threads on alarm, and some also may return up their own lines; therefore, when many are observed hanging thus beneath the lowest boughs, they should be removed by sweeping to and fro in the air with a birch-broom, or pole, or anything of this nature which may be at hand.

Where the plan of destroying the caterpillars in their webs is preferred, care should be taken that this is done when the caterpillars *are within them*. It should be done on an overcast, wet day, or early or late, and it is best for two people to carry out the work. One man should have a pail with some fluid in it,—water and paraffin, or fluid mud with a little paraffin, or anything, in fact, that will prevent the caterpillars that fall in, rambling away. If the pail is held by one man, so that the web-nest cut off by the other falls into it, this is an excellent remedy for such part of the attack as may be in reach. In any case, measures should be taken to prevent stray caterpillars returning up the stem of the tree to the leafage. When the rings of eggs are seen on the Apple-twigs, they should be cut off and destroyed wherever they can be reached. The Lackey Moths harbour in long grass and leaves on the ground, and, therefore, keeping the trees clear of a *neglected* undergrowth, such as is too often seen in uncared-for orchards, is an important measure of prevention. A word may also be said for the Cuckoo as a helper; this bird is particularly partial to *hairy* caterpillars.

The attacks of the Small Ermine Moth are placed next in order, as they lie to some degree under the same means of prevention.

Small Ermine Moth, *Yponomeuta padella*, Linn.; and Small Ermine Apple Moth, *Yponomeuta malivorella*, Westwood.

Caterpillars of the Small Ermine Moths swarmed to such an extent on the trees at Toddington, in Gloucestershire, that in the early part of the summer Capt. Corbett informed me they collected the cocoons by bucketsfull. As in the case of the Lackey Moth, the eggs are fastened to the twigs of the infested tree, and the caterpillars live in companies in web-tents amongst the leafage, on which they feed.



*YPONOMEUTA MALIVORELLA.**

Small Ermine Apple Moth, and cocoons in web; caterpillar much magnified.

The eggs are laid in small patches, covered with gum, and caterpillars may be found in October; and, to continue the history without going into all the details of their early life, in the spring or early summer of the following year they appear on the leafage of the attacked trees (sometimes in vast numbers), and spin webs, where they live in large companies. Whitethorn hedges especially suffer from these caterpillars, and their leafless condition hung with dirty, ragged remains of web-nests is only too well known. Plum, and many other trees, including Pear and Cherry, are stated by various writers to be attacked by these caterpillars, and Apple-trees also, either by this kind, or one exceedingly like it, distinguished as the Small Ermine Apple Moth.

Last summer, amongst various communications on orchard-attacks, specimens of cocoons of this moth were forwarded to me, on July 9th, from Withington, near Hereford, by Mr. John Watkin, with the observation that they were samples of the cocoons of the grubs which had been doing much injury to orchards in Herefordshire, some trees being completely stripped.

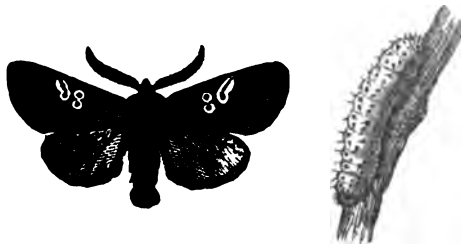
* The attacks of the two nearly allied moths, *Yponomeuta padella*, Linn., and *Y. malivorella*, described by Professor Westwood in the 'Gardeners' Chronicle' for 1849, p. 60, are so extremely similar that it appears to me very difficult to separate them with absolute certainty, unless by examination of the cocoons. I have, therefore, given Prof. Westwood's figure of the kind considered more especially to infest the Apple; but for all practical purposes the kinds may be considered together.

The Small Ermine Moth-caterpillars are of a dirty ash-colour, spotted with black. When full-fed they do not, like many (or perhaps most other) kinds, wander away and bury themselves or spin cocoons on twigs or in localities away from where they fed, but they spin them *in the web-nest*, which sheltered them during their feeding-time. Those of the Apple Ermine are said to be white and opaque. The little moths, which soon appear from the chrysalids, are only about three-quarters of an inch in full expanse of their wings. The fore wings are usually livid, or whitish dotted with black, and the hinder wings lead-colour; but they are very variable in appearance, and the Small Ermine Apple Moths are distinguishable by their fore wings having the black spots on a pure white ground.

Prevention and Remedy.

Shaking the caterpillars down appears the most effective remedy. Something may be done to check attack by cutting off the webs (where they can be reached), and if the webs containing the chrysalids *can* be got rid of, this necessarily is a great check to future increase. The little moths are sluggish by day, and, as they are fairly noticeable from their light colour, when hatching out (as is apt to be the case) in large numbers about the same time,—if the labour was thought worth while,—much egg-laying might be prevented by shaking them down on cloths beneath the trees and trampling on them.

Figure-of-8 Moth. *Diloba ceruleocephala*, Linn.



DILOBA CERULEOCEPHALA.

Figure-of-8 Moth, and ("Blue-head") caterpillar.

Specimens of this fine caterpillar, known in Germany as "Blue-head," were last summer forwarded both from Dorking, in Surrey, and Toddington, in Gloucestershire, amongst samples of the various kinds which were doing mischief in the orchards. The grub is very observable from its comparatively large size, being about two inches long when full-grown, and is also remarkable from the head having usually the bluish colour, whence it takes one of its names. The caterpillar is of various tints of green or smoky-green above, and

yellow-green below, with a small bluish head, and with three yellow stripes along the body, one along the back, and one on each side below the spiracles. The segment or rings of the caterpillar are spotted with black (see figure), the one immediately behind the head has eight small spots arranged (on the upper part) in a double transverse row, and the two segments immediately behind have one row of larger spots similarly placed. The following segments (till near the tail) have four spots above. The three pairs of claw-feet are also spotted with black, and the four pairs of sucker-feet beneath the body have two black spots on each. The caterpillars feed on various kinds of orchard-trees, especially Apple and Plum, and also on Whitethorn. When full-fed they spin cocoons formed of bits of bark, or apparently anything that may be convenient,—on twigs or stems, or even on neighbouring walls,—in which the caterpillar turns to a reddish-brown chrysalis, out of which the moth emerges about September, or possibly later on, in some cases not until the following spring. This is of the size and appearance figured; the fore wings are of a brownish ground colour, with, amongst other markings, two white spots bearing a resemblance to a figure of 8, whence the moth takes its common name. The eggs are green, and laid singly on the stems or branches of the trees.

Prevention and Remedy.

It is noted by Dr. Taschenberg that the caterpillars have such slight hold that in case of a storm occurring they fall off in great numbers. This fact of their loose hold may be very serviceably turned to account by shaking the trees well, and collecting and destroying the caterpillars that drop to the ground.

Amongst measures of prevention, scraping and cleaning the bark of the trees and branches would be serviceable here as with various other insect-attacks, as thus some at least of the cocoons which the blue-headed caterpillars form on the trees would be got rid of.

Mottled Umber Moth. *Hybernia defoliaria*, Linn.



HYBERNIA DEFOLIARIA.

The Mottled Umber Moth; male, female, and caterpillar.

The caterpillar of the Mottled Umber Moth is (as shown in the figure) a "looper," like that of the Winter Moth, but is somewhat larger, and may be easily distinguished from it by its peculiar colouring; it is brown above, with a yellow stripe along each side, the brown and yellow being separated by a waved black line. Like others of the caterpillars specially known as "loopers," it has, instead of four pairs of "sucker-feet" below the body, only one pair besides the pair at the end of the tail; so that in walking it cannot progress forward continuously, but has to bring the sucker-feet and tail-suckers forward to where it is held firm by the claw-feet (as shown in the figure), and thus it forms an upright "loop," whence the name of "looper."

The caterpillars feed on various forest-trees, as Lime, Oak, &c., and it is noted by Kollar that they sometimes appear in great numbers, and do much damage to fruit-trees. They will also feed on unripe Cherries, gnawing away one side of the fruit. When full-fed, which may be during June, or even a little later, the caterpillars turn to chrysalis on or a little under the surface of the ground. From these caterpillars the moths come out in October or November, about the same time, that is, that the Winter Moths appear. Like them, the male moth only is winged. This is of the size and appearance figured, that is, about twice the size of the Winter Moth; the colour is usually of a pale brown or reddish yellow, with dark transverse bands, but sometimes the bands are absent.

The female moth has only abortive wings, and precisely the same methods of prevention of attack which serve for the Winter Moth are of use for this also. The sticky bands placed round orchard-trees towards the end of October or November will catch either kind as they attempt to creep up the tree. If not prevented taking possession the females lay from two to four hundred eggs on twigs towards the top of the tree, from which the caterpillars hatch in the spring; and when this has taken place, the only remedy appears to be shaking down the caterpillars and destroying them.

The two main points of prevention and remedy which have been brought forward last season as really practicable and useful, are shaking and jarring the infested trees, so as to make the pests, whether moth-caterpillars of various kinds, or beetles, fall to the ground; and also smearing the trunks of trees with a band of some sticky material (near the ground-level), so as to prevent wingless female moths making their way up the trunks for egg-laying. The first kind of treatment is applicable for attack of any kind of insect, whether moth, beetle, or otherwise, which will fall to a sharp shake or jar; the second is serviceable not only for preventing wingless moths crawling up the trees, but also for preventing caterpillars returning which have been shaken down.

In regard to shaking the trees as a means of getting rid of caterpillars, Capt. Corbett wrote me from Toddington :—" The only useful plan seems to be to shake the caterpillars into a sheet ; one man collected two gallons in this way." Prof. T. J. Elliott, of the Weald of Kent College of Agriculture, wrote me that on a large fruit-farm five bushels a day could be gathered of small green caterpillars : and, taking the above as samples of amounts which can be collected respectively by one man, or by as many as may be needed for the whole required work per diem, it shows that much good may thus be done. A difference is reported as to the extent to which different kinds of trees will bear the shaking. Mr. T. Buss wrote me, from near Horsmonden, Kent :—" The caterpillars are easily shaken off Cherry-trees ; then a band of gas-tar smeared round the stem prevents their reascending. Apple-tree buds break off more by shaking, and the caterpillars, being more enclosed in the leaves, do not shake out so well."

With regard to the very important matter of it being necessary to prevent the caterpillars, if inclined, going up the tree again, Mr. Buss wrote more in detail. The Cherry-trees were shaken early in June ; no sooner were the caterpillars on the ground than they at once headed for the tree (a distance of three or four feet), and ascended the tree in great numbers, until a band of tar was put round it.

In the exhaustive paper on " Canker-worms," by Professor Riley, Entomologist to the U. S. A. Department of Agriculture, published in 1888, every point appears to be fully entered on which can be of service for prevention of attack similar to that of our Winter Moth, and various sticky mixtures are mentioned and methods of applying them, but the principle is the same as that of our own treatment. Anything that is sticky enough to keep the moths from going up the tree will answer, whether it is tar, tar and oil, resin and oil, bird-lime, printer's ink, slow-drying varnishes, or anything else. Only, what is at hand, cheap, and has been proved to be effective, is best ; and when the need for it has passed, if it has been smeared in thick bands on the bark, it is desirable to *scrape it off*, lest it should presently be damaged by melting in hot sunshine. To avoid this difficulty, the tar, &c., may be applied by means of twisted hay-ropes laid on the ground round the trees, or on rings of clay-mortar, old sacking, or anything convenient. There are special kinds of metal rings or tin bands made which, when dressed with some preventive mixture, stop the ascent of the moths ; and little troughs, made to surround the tree, and filled with oil, or some oily substance, are also noted as useful ; but all this apparatus costs money, and the simpler plan seems preferable.

The great point appears to be to make the applications early enough and often enough, and thus be sure not to let attack begin,

and also to keep the application, whatever it may be, sticky, that the moths cannot pass over the bodies of those already stuck fast, nor the eggs which they lay on the tar remain unkilld. Also, the application should be put near ground-level, not at the base of the branches. The bark is harder and better able to bear application below than above, and also, if the moths are allowed access to the trunk, they will in all probability lay eggs there, and the caterpillars, when hatched, will have no difficulty in creeping up the tree over the band applied months before, over the dead moths stuck to it whilst it was wet. But even with the greatest care, if there is much attack about, probably shaking down will be needed in the summer, on account of the caterpillars being blown as they swing on their long threads from infested trees; and also from the male and female moths being transmitted together by flight.

Amongst various points of useful information, contributed by Capt. Corbett, relatively to prevention of Winter Moth-attack, he mentioned that tarred boards, with a lantern hung up, catch the male moths. I have also seen them caught in large numbers with the female moths on the sticky trees.

Amongst general remedies suited to destroy chrysalids are hoeing and stirring the earth under the trees. Where this can be done, it answers both by destroying some of the chrysalids and turning others out to the birds, and to weather influences. Various caterpillars, or chrysalids, will not suffer from cold, if left in their own self-chosen or self-made shelters, but will perish if thrown out to alternate frost and wet; and, as some proportion of the Winter Moth-chrysalids may possibly not develop with the greater number at the end of October, but remain in chrysalis-state until the following spring, the above treatment helps to clear out these stragglers.

Where orchards are on grass-land, any treatment which will prevent the herbage being long enough to give shelter (as, for instance, to the Lackey Moths) is of use. Also such measures as folding and hand-feeding sheep on successive portions of the ground, until they are bare and sodden and covered with the droppings, is an excellent way of getting rid of insect-pests that harbour on the surface.

But, besides treatment suited to cared-for land and trees, it would be well to give a thought to such a state of things as I have seen for a good part of my life in some places in the West of England, and which may exist still. In those parts it was thought desirable that Apple-trees should touch, so that the upper boughs made a superstratum, and the consequences were that the under boughs gave a shelter and a slow succession of opening to the buds, excellently suitable for insect-multiplication; and in the shade below, the grass grew long and dank, and nettles and weeds grew high and strong,

until nothing but the rough mowing, locally known as skirting, could be brought to bear on the disorder, and clear away what was not in those days suspected of harbouring presence that would lessen returns of orchard-crop.

To what extent birds should be encouraged is a matter for the consideration of the orchard-grower. I fully believe that some of the mainly insectivorous kinds will give help by clearing out eggs and small grubs from nooks which can be got at in no other way, and that these should to all reasonable extent be preserved; but by no means encouraged to such an overwhelming extent that they demolish the very crops they were meant to protect.

In the above notes I have endeavoured, as well as I have been able, to enter on the main points for consideration in orchard-attacks, excepting those of effect of dry dustings, or of washings, neither of which, as far as I know, were much tried for the caterpillar-attacks now under consideration. I wish also to add that, as in the course of last season's observations I found much difficulty in identifying specimens sent me from descriptions only (which often vary considerably from the writers' different views of colour, and other circumstances), that I have now procured type-specimens, properly prepared, and showing variations in colouring, of such injurious moth-caterpillars as may ordinarily be expected to occur, which, in case of recurrence of attack next year, will prove serviceable in identification.

NOTE.—As the attack of the Codlin Moth, *Carpocapsa pomonella*, was not reported to me last year, I merely add a short note regarding it, with figure of injured Apple.

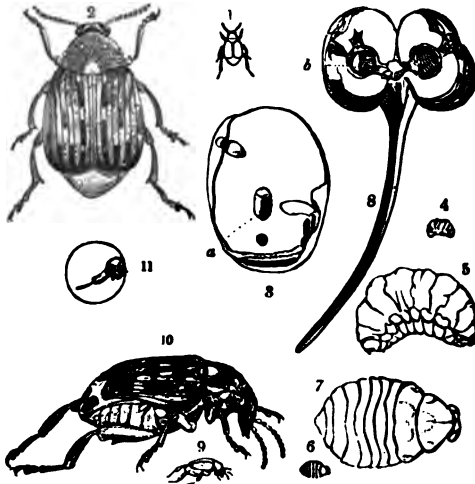
The caterpillars feed within the growing Apples, which consequently fall before they are ripe, and the caterpillars shortly afterwards leave the Apples, and either return to the tree to shelter themselves in the bark, to turn to chrysalids, or go down into the ground for the same purpose. For this attack, therefore, cleansing and scraping the bark, and syringing soft soap into the crannies, likewise stirring the soil round the tree, or poisoning it by sheep treading, are useful means of prevention. Also the fallen Apples should be collected and carried away very soon,—if possible every morning,—and used or destroyed, so that the caterpillars cannot get back to the trees.



Apple injured by Caterpillars of Codlin Moth.

BEANS.

Bean-seed Beetle. *Bruchus granarius*, Curtis; *Bruchus rufimanus*, Boh.



BRUCHUS RUFIMANUS AND B. PISI.

1 and 2, *Bruchus rufimanus*, nat. size and magnified; 3, infested Bean; 4 and 5, maggots; 6 and 7, pupæ, nat. size and magnified; 8, Bean injured by beetle; 9 and 10, *Bruchus pisi*, nat. size and magnified; 11, injured Pea.

Amongst the many insect-attacks which were unusually widespread and severe during the last year, that of the Bean-seed Beetle was one of the first to be reported. The mischief caused by this beetle is from the maggots feeding in the seeds of various kinds of Broad or Tick Beans, and thus lessening their value by weight for sale, and also their value for seed, as, where much is eaten away, the growing power of the young plant from the damaged seed is also lessened.

The method of attack is for the Bean-seed Beetle to lay its egg on the young seed-vessel in the Bean-blossom before this is large enough to be called a pod, and from these eggs the maggots hatch, which presently pierce into the growing Beans. Then each maggot gnaws a gallery for itself, and there, amongst the dust and dirt (consequent on results of its feeding) which remain in the closed-up tunnel, it turns to the chrysalis, and thence to the beetle-state.

The maggots are fleshy, wrinkled across, and with a small, horny, rusty-coloured head. As far as I am aware, they are legless, but in the case of some specimens of *Bruchus*-maggot which I took out of S. African Beans, I found the rudiments of feet on the front segments.

The beetles are only about the sixth of an inch in length, of the shape and pattern of marking figured at 2 (magnified); the colour black, with various markings of brown and white; and they are furnished with ample wings. Imported seed has long been known to be often greatly infested, and the beetles have been recorded as very injurious in our Pea and Bean fields, especially in Kent; but as a general thing (even if present), the attack has not been much brought forward until the present year, when serious damage was reported from various of the more southerly or easterly counties.

The first communication regarding last year's attack was sent me, on Feb. 16th, from Tenterden, Kent, by Mr. J. Ellis Mace, who mentioned, with respect to some Winter Beans, regarding which we had previously been in correspondence, as follows:—"The crop turned out fairly successful for a dry year, yielding from six to seven sacks per acre. . . . On threshing out the crop, we found numerous holes in the Beans, which were put down as the work of the maggots; but yesterday, on examining some crushed Beans, we found the work was done by a little beetle or insect of some kind, which I never recollect to have seen before. . . . The insects, being alive in some cases, I am afraid will get into other corn, and will necessitate immediate use of the Beans." These beetles I found, on examination, to be the kind of *Bruchus* now known as *rufimanus*, and, for further certainty, I submitted them to examination of Mr. Oliver E. Janson, who confirmed my identification as correct.

On Feb. 21st, Mr. Ellis Mace mentioned:—"I do not recollect to have noticed anything in the seed, but we unfortunately sowed some of these very Beans last autumn, and the men noticed, when drilling, that there were some cases, and put it down to maggot." On the 25th, Mr. Mace gave further notes as to unusually large amount of Bean-seed attack; also the history of the seed reported on; and likewise the deficient amount of germination which had been observed in the case of the infested seed. Mr. Mace mentioned:—"A large miller in this country tells me these insects are very common this season. He thinks nearly every sample he has seen since harvest was affected: he has often seen it before, but never to so great an extent. Last Tuesday, at Ashford, he says he bought a sample of 'ticks,' and directed the seller's attention to the fact that nearly every Bean was bored. He does not advise drying on oast-hair, but thinks great care should this year be exercised in selection of seed-samples. We unfortunately sowed ours in September, and the Beans not coming up evenly was attributed to the very rough state of the ground, which my men did not work sufficiently before the drill. I do not think I told you about the seed; it came from Wrotham, near Sevenoaks, and was

sown in Tenterden in the autumn of 1885. From that crop my seed was got, and sown at Benenden in 1886."

On March 2nd, Mr. F. W. Silvester (Recorder of Economic Entomology of the Herts Nat. Hist. Soc.), mentioned that he had been informed that the Bean-seed beetle was much more prevalent than usual in Buckinghamshire, and also on the lesser amount of land on which Beans are grown in Herts.

On March 1st, I was favoured by the following notes from Mr. E. A. Fitch, of Maldon, Essex, which are of especial value, from Mr. Fitch being not only an agriculturist on a large scale, but also a well-known entomologist, and for some years Hon. Sec. of the Entomological Society of London. Mr. Fitch wrote:—" *Bruchus rufimanus* has been most destructive this year: in Essex it is a most general complaint, and in my own case a most moderate computation of loss of weight alone of 2s. per quarter, would give £65 12s., i.e., 164 acres \times 4 quarters the acre \times 2s. per quarter. *Bruchi* are always common with us, but seldom (if ever before in my recollection) to anything like the extent they have prevailed this year. I generally have heaps of Beans threshed in my granary for use (grinding for bullocks),—have over 100 quarters there now,—and every May and June they seem alive on the top, but we are used to that; this year, certainly, I believe I have as many *Bruchus* larvæ as I have Beans, and the wild oats sticking in the holes is a perfect nuisance. I am a clean farmer, and, perhaps, ought not to acknowledge wild oats; but they seem to a certain extent a necessity of our heavy land, and this year every oat has got into a *Bruchus*-hole, and nothing short of hand-picking would remedy the evil: this is almost impracticable. . . . I know *Bruchus rufimanus* but too well."

The following note from Mr. Fitch, which he also permits me to use, gives a somewhat more detailed report:—"The much-talked-and-written-of Hessian Fly has not been nearly as destructive in Essex last year (1887) as this small beetle. The complaint of holey or bug-eaten Beans comes from all over the country, and is by no means confined to the Bean-growing lands; where Beans have been grown on our light land, they have suffered equally with those usually grown on the heavy land. I have myself delivered Winter Beans in other years weighing 19 stone 4 lbs. (67½ lbs. per bushel), and this year none of mine have quite weighed 18 stone (68 lbs. per bushel); and I hear from the corn merchants that nothing over 18 stone can be expected this year; a year in which condition, and consequently weight, is exceptionally heavy, the loss being entirely due to the ravages of the *Bruchus*. Certainly, more than half the Beans I grew (produce of 164 acres), produced a *Bruchus*, some two and more; money loss was created from the fact that all the wild oats (*Avena fatua*) seem to have

taken possession of the *Bruchus*-holes, from which it is impossible to dislodge them. This spoilt the sample for sale,—was annoying for use, for grinding did not effectually destroy the oats; and I shall be obliged to purchase fresh and cleaner seed, if I can get it. My spring (May and June) Beans were bad, but the Winter Beans suffered immensely; and so it is almost everywhere."

The following note from Manifold Wick, Kelvedon, contributed on June 11th, by Mr. J. J. Harrison, further shows the prevalence of the Bean Beetle in Essex, and the direct loss caused by the injury:—"I enclose you a sample of Beans grown on this land, which have been considerably depreciated in value for some years by beetles, some of which I enclose also. For some years they have been a pest, but never so bad as last year, when they perforated the Beans to such an extent as to make them unsaleable."

The above notes show the prevalence of injury from the Bean-seed Beetle in Essex and Kent and in Buckinghamshire, and also to some extent in Herts; and the following note shows its presence at one locality in Bedfordshire:—

On April 4th, Mr. G. F. Street, of Maulden, Ampthill, in reply to my enquiries as to *Bruchus* in English Beans, forwarded me a sample of Beans that he had grown for four years, the seed of which originally came from Biggleswade. In the sample sent, which was of about thirty-five Beans, seventeen were still infested, the beetle in most cases showing close to the round hole in the Bean, from which the sound bit of skin had been pushed off; about nine or ten Beans had been infested, but the beetle-gallery or tunnel was now empty. The remainder were variously injured or deformed, but beetle-presence was not certainly observable.

Beans that are still infested by the beetle may be known by having a little round depression in the skin, which is also, at this spot, slightly yellowish or transparent. This appearance is caused by the substance of the Bean having been eaten away inside by the maggot, which gnaws its gallery in the seed up to the skin, so that this sinks a little into the hollow space. When the beetle emerges, it pushes this circular bit of skin off, and the round holes thus caused show that the seed *has been* infested. The above points are desirable to look to in choosing seed. Autumn-sown seed is most likely to be infested, as a large proportion of the beetles do not come out till the end of winter, or, in some cases, well on in spring.

In regard to methods for lessening amount of loss from this attack, one is, great care in examining samples of seed before buying. As the young plant, when first sprouting, lives much on the store of food laid up in the large seed-leaves, it would be expected that where much of these had been eaten away, this would weaken the young plant,

or prevent it starting; and the note of Mr. Ellis Mace at p. 20 shows such to have been the case with his crop from infested seed. It would be exceedingly desirable, if possible, only to buy seed which showed no signs of being infested; but next after this, to save future attack, it would be very desirable to kill the beetles in the Beans before they come out to fly abroad.

In experimenting on infested Beans, I found that, if placed for a short time to soak, the water passed through the thin film of coating of the Bean at the end of the gallery, and soddened the powdery dust and rubbish within, and thus choked the breathing-pores of the beetle lying within, and killed it. If simple wetting in this way would answer the purpose, this would save trouble, likewise the expense and some degree of risk in using chemical additions; but it is open to doubt whether, if weather was unfavourable for sowing, when the Beans had been wetted, they might not be harmed; and the two following notes mention successful use of Calvert's Carbolic Acid and McDougall's Sewage Carbolic. Mr. J. J. Harrison, in addition to the observations given above, mentioned:—

"In sowing this year I dressed all the seed with Calvert's Carbolic Acid, of such strength as to kill all the insects in the Beans without damaging the seed."

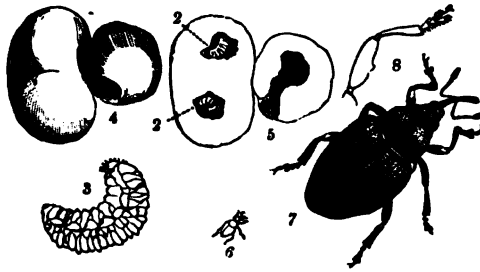
In the course of discussion on this subject, at the meeting of the Farmers' Club, at the Salisbury Hotel, on April 80th, Mr. Geo. Street, of Maulden, Amptill, mentioned that he had found good results from dressing infested Beans with "blue vitriol" and McDougall's Sewage Carbolic. A great number of the beetles were killed; but, as all were not destroyed (at my request), he promised further information. On May 10th, Mr. Street wrote as follows,—and, firstly, with regard to whether the dressed Beans would be found to be injured thereby:—"They were then only just coming up, and I wished to see the result before writing to you. They have made wonderful progress, and the result, as far as I can see, is so far perfectly satisfactory. The dressing applied to the Beans was used in a similar way to that used for seed-wheat. Formerly we used 'blue vitriol' only, but the addition of McDougall's Sewage Carbolic leaves a smell, which to some extent prevents birds eating the seed-corn. I am inclined to think the carbolic alone would be sufficient, if a larger quantity was used. We used 6 bushels of Beans, 6 quarts of water, 1 lb. of 'blue vitriol,' and 1 pint of Sewage Carbolic. I am inclined to think that Beans should be dressed some few days before they are sown (as the skin is thick), and turned over with a shovel every day. Those which escaped the liquid dressing might be killed by the strong dust which would be formed when the Beans were again dry."

From the above notes of practical field experiments, it would

appear that this attack at least might be held in check. Where Beans or Peas are grown over large districts, as, for instance, in Canada, or other seed-supplying countries, the only real way to reduce infestation thoroughly, from time to time, is a change of crop to something that the *Bruchi* (or Bean- and Pea-seed weevils) will not attack. Also, it is a very simple and desirable precaution, on the part of seed-supplying firms in this country, in case they have reason to know that there is bad infestation in whatever part of the world they may usually procure their supplies from, to change, temporarily at least, to another. It is a powerful argument in inducing proper attention from their suppliers, and is but just to their customers; and I venture to draw attention to the subject, as I am aware of this being done by one at least of our most leading seed firms.

CABBAGE.

Cabbage and Turnip-Gall Weevil. *Ceutorhynchus sulcicollis*, Gyll.



CEUTORHYNCHUS SULCICOLLIS.

1—5, galls, with maggots (maggot magnified at 3); 6 and 7, weevil, nat. size and magnified; 8, leg of weevil, magnified.

The Cabbage and Turnip-gall Weevil does mischief by causing the growth of the smooth knobs, or clusters of knobs, often observable on the bulbs of Turnips and Swedes, and also on the underground part of the stem, or even the roots of various kinds of Cabbage. These galls do little harm in themselves, so far as Turnips are concerned,—that is, unless they are very numerous, or cause decay by wet lodging in the hollows in the galls, from which the maggots have escaped. But with Cabbage it is different. Here the gall-growths on the old stocks are not available for food as they are with the Turnips; they carry off the sap in the wrong direction, besides inducing decay.

Although the gall-swellings are different in their cause and nature from the disease known as "Anbury" or "Finger-and-Toe" in

Turnips, and as "Club" in Cabbage, which are caused by a fungus, yet the two attacks are often confused together, and, in the case of Cabbage, are often to be found on the same stock. As this point is often inquired about, and the same kinds of treatment and applications to the land are useful for getting rid of both the fungus and the insect-attack, the following remarks may be of some interest.

The notes on the gall-weevil are mainly from my own observations taken near Isleworth, where I have seen badly-infested Cabbage-stocks lying in cart-loads, where they have been thrown in heaps when the fields were cleared.

The Turnip and Cabbage-gall Weevil is a very small blackish beetle, about the eighth of an inch long, and of the shape figured (magnified) at p. 24, which shows the long fine proboscis, or snout, with the "elbowed" antennæ, or horns, placed on each side; also the channel along the middle of the thorax, and striæ, or furrows, along the wing-cases. The colour is black, with grey or white scales beneath, and sometimes a sprinkling of them above.

The method of attack is for the female either to make little holes with her proboscis, in which to deposit her eggs,—usually one in each hole,—or else simply to lay them on the surface of the Turnip-bulb, or Cabbage-stock or root, as the case may be. The maggots which hatch from these eggs are, as figured, thick and legless, very much wrinkled across, and white or yellowish. The head is furnished with strong chestnut-coloured jaws, darker at the tips, and armed (see figure, p. 26) with two teeth, and also sometimes with a third much smaller tooth on the inner side. The maggots, which I took from Swede-galls, differed slightly from those taken out of Turnip or Cabbage-galls in the two teeth being smaller, and the third, or tubercle, being absent (see fig. 1, A, B, C, p. 26); also, as might be expected, in being, like their food, of a more ochreous colour.

The gall-maggots are for some time hardly observable within the galls, which their presence has given rise to, but after a while, as they grow and eat out the centre of the gall with their strong jaws, they may be found either singly, in separate galls, or (where the galls are in clusters) there may be a group of little cells, communicating with each other inside, and each with a maggot within.

When full-fed the maggots leave the galls and make earth-cases, in which they turn to the pupal or chrysalis state. These cases they form by first securing a little bit of the material lying close to them with the tip of the tail, and then, with their jaws, and moisture from the mouth, fastening on to this beginning little morsels of pebble, sticks, earth, or whatever may be within reach, and so forming a solid case around themselves. If disturbed in this operation, the maggot will drag its partly-formed case with it, or if the case, when newly

made, is broken, I have seen the maggot complete it again. The quantity of moisture used in fastening the particles of earth together is so great, that wet patches can be observed inside the case as the work goes on. When complete the case, or earth-cocoon, is smooth inside, and lined with a kind of whitish or yellowish gummy material, and it lies (as figured below) in a hollow in the ground from which the

Fig. 1.



Fig. 3.



Fig. 2.



Fig. 1.—A, B, C. Jaws of Turnip and Cabbage and Swede-Turnip weevil larva respectively, magnified.

Fig. 2.—Earth-cocoon of the gall-weevil chrysalis, and chamber in which it lies, magnified.

Fig. 3.—Cabbage-root, with galls of the weevil *C. sulcicollis*.*

material was taken. The time occupied from the maggot going into the ground to the perfect beetle coming up from it was between fifty-four days and two months in the middle of summer, in the instances that I watched.

The beetles may be found from spring onwards during summer, and some maggots still in the galls in winter; and the maggots bear being frozen hard without the slightest apparent injury, for on being thawed they will at once go down into soft earth, and begin to build up their earth-cases.

Prevention and Remedy.

With regard to Turnips and Swedes, the simple fact that in common rotation the crop comes at sufficient interval to prevent the ground harbouring the weevils, or morsels of maggot-infested pieces from the preceding root-crop, is usually a great security; but where, in Cabbage-growing districts, one Cabbage crop may be put in after

* The above figure, from my paper on *C. sulcicollis*, in the 'Entomologist,' vol. x., p. 246, is inserted by kind permission of Mr. T. P. Newman.

another, with only interval enough to lay a heavy application of manure on the land, the weevils are likely fairly to swarm.

The following observation, forwarded on June 22nd last, from a Sussex correspondent, gives some idea of the manner in which infestation may remain from a preceding crop :—

“ I have just planted a rather large piece of ground with Brussels-sprouts, on land where sheep had fed off Rape this spring, and I find that many of the small Rape-stems lying in and about the ground have galls on them, evidently formed by the Cabbage-gall Weevil; some of these galls are empty, and some have maggots in them.”

These maggots would, of course, carry on infestation, and where Cabbage is a constant crop of the district, it is very important to burn all the old stocks, or, at least, so destroy them that there is no possibility of the maggots causing recurrence of the trouble. If the stems are only lightly buried, or thrown to rot-heaps,—this does no good; for it will not hurt the maggots, and in due time the beetles will force their way up again to start new attack.

Rotation with other crops is the best cure, but where Cabbage (including under this term Rape, Cauliflowers, Brussels-sprouts, or other plants of the Cabbage tribe, wild or cultivated, that are liable to this infestation) must be constantly grown, then the best application to the land appears to be gas-lime. This has been found useful for clearing infested ground, applied broadcast and pointed in, or as a dressing accompanied by deep trenching.* Where the area to be dealt with is not too great, trenching, if thoroughly done, is of great service in getting rid of attack, for if the top spit of land, with the maggot-cocoons or weevils in it, is turned down, and the lowest spit laid on the top, then the working part of the land (for a while at least) is purified from the infestation. Dressings of fresh field-soil are very useful in infested gardens.

In planting seedlings, those that are already galled should be rejected, or, if possible, the galls should be removed. Wood-ashes are said to be a good preventive for attack on the roots, and dressings thrown on of sand, or ashes, or dry earth, with paraffin added in the proportion of one quart to a bushel of the dry material, would be very likely to be of service in preventing the weevils going down for egg-laying.

The diseased growths known as “Club” in Cabbage, and as “Anbury” or sometimes “Finger-and-Toe” in Turnips, consisting of swollen masses and misformed roots, followed in bad cases by cracking and bursting of the surface, and putrefaction are only too well known.

* For method of application, see p. 30.

In Germany the disease is more or less known by a word signifying rupture or hernia, or in combination, a breaking or decay. These diseased growths are easily distinguishable from weevil-galls, which are only knobs, or clusters of knobs, with a maggot inside each, or an eaten-out cell with a hole in the side showing where the maggot has been. This "Anbury" or "Club" disease, caused not by insects, but by a kind of fungus known as "Slime-fungus," scientifically as the *Plasmodiophora brassicæ*, are not unfrequently sent me. I append a short note of its cause and the treatment for its cure, taken mainly from the chapter on this fungus given by Mr. Worthington G. Smith, in his serviceable volume on 'Diseases of Field and Garden Crops.'*

This peculiar slime-fungus was discovered, in 1876 by M. Woronin, to be the cause of "Club," and (without going into the minutiae of growth), may be generally described as a mass of matter which has a power of creeping onwards by what are somewhat like arm-like processes, into which the material of the central mass or *plasmodium* presses. This mass, outside its enclosing layer, has been observed to be further enclosed in a coat of mucilage, "which is sometimes left behind by the progressing *plasmodium*, like a trail of slime from a slug." This slime-fungus is stated to be often present in soil, but when infested pieces of root are left about, the fungus, or the composing parts of it called *plasmodia*, are washed by rain from the decaying "Club," or "Anbury"-diseased root, on to the ground where they live on in a condition in which the fungus will grow on so as to start attack on fresh plants of the kinds which it infests, which it may reach.

Details of experiments are given in which seedling Turnips on fresh soil remained *undiseased*, whilst those which were grown from seed sown amongst earth with broken-up "Club" in it, became *fatally diseased*.

It appears to be proved that the fungus in dilute condition is absorbed like any ordinary moisture or moist food by the rootlets of the Turnip or Cabbage, and thus the disease is conveyed into the plant-system. Further, it appears that the fungus may remain on from one year to another after bad infestation.

Some very important means of prevention and remedy turn on the above points, namely, not to allow Turnip- or Cabbage-roots diseased with "Club" or "Anbury" to remain on the land, or to be thrown to refuse or dung-heaps, whence the infestation is quite sure to be carried back to the land with the enrichment. Also on land which is known to be specially liable to suffer from this disease, the length of time in

* 'Diseases of Field and Garden Crops,' by Worthington G. Smith; with one hundred and forty-three illustrations. Macmillan, London.

the rotation before Turnips or Cabbage are admitted again should be increased. Where it can be done thoroughly, trenching so as to put the fungus-infested soil below and fresh above is good treatment.

Lime or manures, such as chalk, and others which contain lime, have been amongst the applications which have been advised for land subject to "Club" or "Anbury," and amongst these, as far as I can judge from such information as I have access to, and my own personal observations for several years, gas-lime stands first.

So long ago as 1859, the late Dr. Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society, noticed (in his paper on "Anbury," in the 20th volume of the Journal of the Society) a case in point. On a sandy field at Ashton Keynes, near Cirencester, Dr. Voelcker found the Turnips diseased with "Anbury" to such an extent that there was scarcely a sound Turnip to be seen, excepting on two spots. On one of these spots, not many yards square, the Turnips were nearly all sound, and bits of a whitish substance were on the surface, which, on investigation, proved to be remains from a cart-load of gas-lime which had been unloaded there in the year before. On the other spot likewise there was hardly one diseased Turnip to be found, and in this case the Turnips grew where a dung-heap had been set up in previous years; and to this Dr. Voelcker attributed the greater proportion of lime which was found in the soil at this spot to what was found in the field generally. The analysis of soil from the gas-limed part showed, as might be expected, presence of gas-lime.

In a note on the uses of gas-lime, published some time after (see foot-note, p. 81), Dr. Voelcker mentioned that at his recommendation the occupier applied a heavy dose of gas-lime, which completely cured the evil.

In my own garden near Isleworth, I found the Cabbages "clubbed" to a very serious extent, and, experimentally, I had the cleared ground in the kitchen-garden dressed throughout with gas-lime as a regular thing in the autumn. It was laid on so as to be a light sprinkling, if absolutely fresh, and more thickly if the gas-lime had been exposed to the air, and, in due course of winter working, it was forked in. Under this treatment the Cabbage ceased to "club," so that (as far as I saw or had means of judging) the disease, before I moved to St. Albans in 1887, had ceased to infest the soil. About the year 1874, when I went to live near Isleworth, I could have gas-lime for the asking at the Brentford works, but before I left its use had increased so much in that Cabbage-growing district, that Mr. Wilmot, well known as one of the leading market-growers, said that they should not know how to do without it; and personally I found that I had to pay from 6s. to 7s. 6d. a load for what previously had only cost cartage.

The following note, sent me by Mr. Herbert S. Daines, of Woolfall Hall Farm, Huyton, Liverpool, refers to use of "waste" from alkali works, which is employed very serviceably in the same manner as gas-lime. The analysis of the "waste" from the Widnes works, which I was favoured with a few years ago, showed what was submitted then to have rather a larger proportion of the lime constituents present in it than in ordinary gas-lime (each, of course, being presumed to be in fresh condition, and therefore it required greater caution in use at first). After exposure to the air, and thus being altered in chemical condition, it was found to answer well, as noticed below, when used in very large quantities. Mr. Daines' observation draws attention, amongst other points, to the method of exposure of the "waste" to the air (*i. e.*, oxidation) to turn it to a valuable manure.

"*Re* 'waste,' for use in product similar to the Widnes article obtained from St. Helens: our practice is to cart it in summer, lay it up in a huge heap, turn it over thoroughly to oxidise it, then, in autumn, spread on stubble, leaving exposed for several weeks in order that oxidation may still further be accomplished; the result is, we obtain a sulphate of lime, which, as you know, is a useful manure. If land be very foul, the 'waste' may be applied in a crude state, but care must be taken in spreading, and sufficient time allowed before ploughing in: weight per acre, ten to twelve tons."

Without going into the chemical questions involved, in consideration of the constituents of soil adapted for Turnip land, it seems to me that the gas-lime acts on both the fungoid and the insect-attack by its acrid and poisonous qualities.

The weevil-grub builds up its cocoon of little bits surrounding it, which it moistens from its mouth, and the dilute gas-lime may, I think, be very detrimental to it; and, in the case of the "Slime-fungus," the good which has been proved to be done appears likely to be caused by,—in some cases killing it downright with the gas-lime, which will kill much stronger vegetable organisms, and in others by giving food to the fungus, on which *it perishes*.

With regard to amount of gas-lime that can be safely used, and the time of application, it should be laid on arable land when clear of crop in autumn or winter, and allowed to be exposed to the air for at least four weeks before being ploughed in. Thus, by exposure to the air, the nature of the lime, which at first does good by its acrid properties, killing what is subjected to it, is so altered that it is changed to sulphate of lime, a manure suitable for all land on which gypsum is of use, and especially serviceable to many leguminous crops and Turnips.

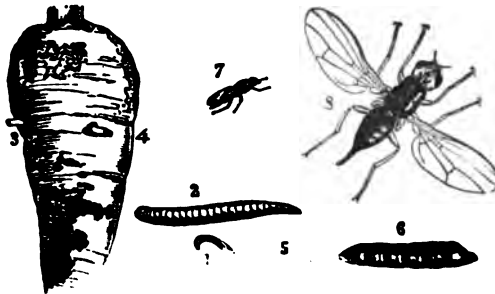
The quantity mentioned by Dr. Voelcker as safe is two tons per acre, applied as above; but the further amount that is desirable depends on the strength of the gas-lime, the nature of the soil, and

other points, as nature of succeeding crop, and time that can be allowed for the gas-lime or "waste" to be exposed. Those who wish to go into the nature and uses of gas-lime as an application to the soil will find excellent observations in Dr. Voelcker's four-page leaflet, of which the title is given below.*

I must also add on my own account that, although a fungoid disease and its cure do not lie in my own department, yet, as they have been constantly brought under my notice and study for years, I hope I shall not be considered trespassing out of due limits in giving the above notes much based on the observations of two such widely-known and eminent authorities as Mr. Worthington G. Smith and the late Dr. Aug. Voelcker.

CARROT.

Carrot and Parsnip Fly; "Rust." *Psila rosæ*, Fab.



PSILA ROSÆ.

1, 2, and 3, maggots, nat. size and magnified; 4, infested Carrot; 5 and 6, chrysalids; and 7 and 8, Carrot Fly, nat. size and magnified.

"Rust" in Carrots is so called from the peculiar yellowish or rusty colour of the parts injured by the Carrot Fly maggot. Whilst the Carrots are still young, the maggot-galleries are often, or most commonly, to be observed towards the outside of the lower part of the root; later on they may be found in any part of it, and sometimes penetrating to the middle.

The presence of the mischief may often be known by the yellow colour and the withering of the leaves, and, if a root is carefully withdrawn from the soil, the little maggots may be seen sticking (by

* "On the Composition and Use of Gas-lime in Agriculture," by Dr. Augustus Voelcker; four pages. Reprinted from the 'Journal of Gas-lighting,' &c. Printed by W. King and Sell, 12, Gough Square, Fleet Street, London. (Probably procurable on application, or through a bookseller.)

about half their length), out of their burrows, as figured above. The attack affects Parsnips as well as Carrots.

The maggot, when full-grown, is about a quarter of an inch long, whitish or yellowish in colour, shiny and parchment-like, cylindrical, legless, blunt at the tail, and prolonged at the head extremity, which contains the black, hooked tip, forked at the base, with which the maggot makes its way into the roots. When full-fed (in summer) the maggots leave the roots, and turn to rusty-brown or ochre-coloured chrysalids in the ground (see figure), from which the fly comes out in about three or four weeks; so that new attack may be constantly arising throughout the warm part of the year.

The fly (figured at p. 81) is two-winged, about a quarter of an inch long, shining black with a green tinge, and with roundish and rusty ochry head, and yellow legs. The two wings are iridescent, with yellowish veins.

Both chrysalids and maggots may be found in the winter, and the beginning of the year's attack is caused by the flies coming out of the hybernated pupæ, or chrysalis-cases, and laying their eggs by the Carrot-plants a little below the surface of the ground.

Last season application was made regarding the attack from Falconer's Hill, Daventry, on July 14th, as a small white worm, which was then found in multitudes, and "destroying Carrots and Parsnips with fearful rapidity. . . . The land is of excellent quality, well-manured and cleaned, one portion dressed last year with gas-lime, the other with farmyard-manure, and both suffering alike."

A little later on, I had notes of the same attack from Mr. Cyrus Morrall, of Plas Warren, Ellesmere, Salop, who mentioned that "a good many in the neighbourhood have had their Carrots attacked. The ravages seem to have been worst where the Carrots were thinned early, or where (in one instance) they have been grown on the same ground as last year."

Prevention and Remedy.

The point immediately above is one of great importance in Carrot cultivation. Where Carrots have been grown (and at all infested) the year before, most of the maggots will have gone into the ground in autumn, and there, or possibly in stray bits of infested Carrot, they will have turned to chrysalids, from which the flies will come out to attack the new crop of Carrots. Where land is thus infested, trenching, so as to throw the top spit below and bury it down with the pests in it, is the best remedy, if the trenched-down soil can be left undisturbed; if it is brought up again before June, the trenching would be no use; but failing this, clearing away all the bits of decaying Carrot and forking the surface does some good. By this means many of the maggots or chrysalids are thrown on the surface,

and if a sprinkling (about enough to give the appearance of hoar-frost) of gas-lime, in absolutely fresh and caustic state, was thrown on the surface, it could not fail to kill those of the pests that it touched. Of course, as before mentioned (see p. 80), some weeks must be allowed to elapse before land so treated is safe for cropping or sowing. Where ground has been rough-dug at the beginning of winter, sprinkled with gas-lime, and the gas-lime then pointed in about four inches deep, this plan has answered; the Carrots have been found to escape "rust," whilst those not so treated were destroyed.

For prevention of attack generally, what is needed is a well-prepared soil which will push on good growth of the plant, and also not be liable to crack, and also such management of ground and plants at thinning-time as will not allow the Carrot Fly to get down to lay its eggs by the roots. *This point is the important matter in prevention of the Carrot-grub attack, commonly known as "rust."* If the fly cannot get to the roots to lay her eggs, obviously there will be no maggots to harm them, and the reason why Carrots which have done well up to thinning-time often fail afterwards, is *because the ground is thrown open in the operation.*

To get over this point, treatment which will close up the soil as much as possible after thinning is needed, and waterings, with an addition of something which will be deterrent to the fly, and also will push on vigorous growth (as guano or soot and water), are especially useful. I have myself stopped attack (which only commenced after thinning) by watering with a very dilute form of a preparation called Soluble Phenyle. The injury was stopped, and the plants thrown into vigorous growth. Paraffin has been found very successful in checking attack. If applied in fluid-state, care must be taken that it is not strong enough to burn the plants, and probably a little in a solution of soft-soap would be the safest form: 8 lbs. of soft-soap and one pint of paraffin in 25 gallons of water, raised to boiling-point in mixing, would perhaps be as good a proportion as any; but no rule can be given—trial must be made. Paraffin dressings would be of use, mixed with sand, dry earth, ashes, or other dry material. A proportion of a quart of paraffin to a bushel of the dry material has been found not to injure perfectly tender young shoots of other plants.

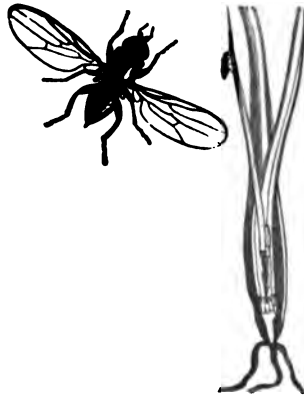
But the great point is to keep the Carrots protected from possibility of fly getting at them. In the heavy thunderstorm of June 26th, in 1888, a rainfall at the rate of nearly two inches an hour fell during about three-quarters of an hour at St. Albans, sweeping all that was movable before it in gardens or road, down the steep slope of Holywell Hill. In my own garden a bed of Carrots, upwards of 63 ft. long and about 4 ft. wide, lay across the slope, with plots of garden ground above, and a thick border of box varying from 8 to 4 ins. below it.

This border stopped the fine soil swept down the slope, so that the Carrots were thoroughly earthed up to the level of the top of the border with good soil fitted into every cranny. The result was satisfactory in the highest degree. The Carrot-foliage was luxuriant, and in autumn we have housed a crop of well-grown delicate roots without a taint of "rust." One cannot command the misfortune of a sweeping flood to help one's Carrots, but the unusual occurrence showed the success of the principle of thorough protection.

It does not appear desirable to enter on the methods of prevention at full length here, as I have previously given them elsewhere,* but the principle of prevention may be shortly described as sowing on land free of infestation, and so well prepared beforehand that the roots will have a good luxuriant growth; using all means at thinning-time to keep the fly from being able to get at the roots, amongst which watering with applications deterrent to the fly and stimulating to the Carrots are desirable, and, if it could be managed, earthing up the Carrots; also being careful to remove all drawn plants or broken pieces away from the beds at thinning-time, as these specially attract the fly.

CORN.

Frit Fly. *Oscinis frit*, L. (? *Oscinis vastator*, Curtis).



OSCINIS VASTATOR.

Perfect fly, nat. size and magnified; and attacked plant, with maggot inside.†

* See my 'Report on Injurious Insects for 1880,' and also 'Manual of Injurious Insects,' published by Simpkin, Marshall & Co., Stationers' Hall Court, London, E.C.

† The *Oscinis vastator* of Curtis bears such a strong resemblance to the *Oscinis frit*, which is the subject of the present paper—even if it is not absolutely the same—that I have used Curtis's figure to give the appearance of the insect and its method of injury.

During the early part of last summer much damage was done to young plants, both of Wheat and Oats, by fly-maggots feeding within the central shoot. No difference was observable in the method of injury to each kind of crop, but on microscopic examination of the small, white, legless maggots that caused it, these proved to be clearly distinguishable, one kind infesting the Wheat-plants, the other the Oat-plants. In due time the maggots went through their changes up to the perfect flies, showing the Wheat to be infested by the maggots of a small two-winged fly, scientifically the *Hylemia coarctata* (which is described further on in this Report under the heading of "Wheat-bulb Maggot"), and the Oat-plants to be infested by the maggots of the "Frit Fly," the *Oscinis frit*.

This is a small, very brightly shining, black, two-winged fly, rather under the eighth of an inch in length. "Legs black, the tarsi (feet) of the hinder pair, with the exception of the end joints, yellow; the fore feet brown-yellow, the midmost often much darker; the wings transparent, somewhat brown at the fore edge."* It is also distinguishable by its peculiar habit of dancing or skipping about, which has been very noticeable in the specimens I have reared. This fly is common in various parts of the Continent, and especially recorded as present in France, Germany, and Sweden. It attacks both Oats and Barley in the manner only too well known to us by last season's damages, when so much of the young Oat-plant was destroyed in May and June by the maggot feeding within the young plant. But besides this early attack, great damage was recorded formerly in Sweden from the second brood, the maggots of which fed on the soft grains in the ears of Barley, and thereby caused the light worthless development of the corn, known in Swedish as "frits," whence the name of the fly.

Up to the present year, I am not aware of this attack being prevalent to an observably injurious extent in Britain, although the presence of the *Oscinis vastator*, Curtis, which appears, as far as can be made out, to be the same as the *O. frit*, Linn., was watched and recorded in 1844 by John Curtis, in his 'Farm Insects.' In 1881 I was favoured, by Mr. R. H. Meade, of Bradford, with the information that the *Oscinis frit* had been observed in the autumn of that year in swarms in an outbuilding, in the lofts of which a lot of newly-threshed Barley had been stored; but it was not until last year (1887) that I was able to watch this attack throughout its course up to development of the fly as a regular field attack to young Oat-plants. To be absolutely certain as to the identity of the fly, I submitted samples of what I had reared to Mr. R. H. Meade, who was good

* For description of the "Frit Fly," see 'Fauna Austriaca die Fliegen,' by Dr. J. R. Schiner, ii. Theil, p. 224; and for description in all its stages, with life-history, see 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg, pt. iv., p. 151.

enough, both last year and again this year (with samples from the far worse attack of this season), to examine them, and confirmed my opinion that they were the true *Oscinis frit* of Linnæus.

The maggot is about the eighth of an inch long, whitish, legless, cylindrical, bluntly pointed at the head-end, which is furnished with a strong pair of curved mouth-hooks, and on each side near the head it has a branched spiracle. At the blunt hinder extremity it has two projecting wart-like spiracles.

The chrysalis is rather smaller than the maggot, cylindrical, and rather more pointed at the front than the hinder extremity, which, from the strong projection of the two wart-like processes, has the appearance of being cleft, or almost bluntly forked. In the specimens of empty chrysalis-cases now before me, I find the peculiar dark, somewhat star-like, marking, which is described by Dr. Taschenberg, and was also figured in a series of sketches of details of the puparium, with which I was favoured by Prof. Harker, of the Royal Agricultural College, Cirencester. In the early condition of puparium the branched external spiracle on each side near the head-extremity is very clearly observable. During the course of last year's attack, I have been able to secure specimens of the larva (or maggot) of the puparium or chrysalis, both with contents and empty, and of the perfect fly; so that I shall have no difficulty, if the attack should recur, in identifying it.

The injury is caused by the maggot feeding in the heart of the young corn-plant a little above ground-level, and eating away the centre, so that the shoot above the eaten part is destroyed, and the damage that is going forward then becomes noticeable from the injured shoots turning brown, and withering instead of continuing their growth. This was chiefly observed in last year's attacks at the end of June, and in the earlier part of July, at which time the maggots were leaving the inside of the infested young plants to turn to chrysalids in the dead or dying remains of the outside leafage: from these chrysalids the flies began to appear about July 9th. We had no notes of observations of the method of the beginning of the attack to the young plants, but this is stated by Dr. E. L. Taschenberg (see reference, p. 85) to be for the female to lay her eggs on the under side of a leaf, and for the maggots from these eggs to eat into the heart of the young plant, and then begin the mischief, which we know only too well.

On June 27th, I received the following communication from Mr. Geo. Thomas, of Coosenwartha, Scorrer, Cornwall, accompanied by specimens of yellow and diseased Oat-plants:—"There are great complaints in this neighbourhood of the Oat-crop being destroyed by a small maggot, which eats the centre of the stalk, and is perceived

when the corn is about a foot or eighteen inches high. It will then droop and decay, fresh shoots starting at the bottom. I enclose you samples of the damaged corn with maggot within. It is a peculiar fact that in 'dredge-corn' (i. e., Barley and Oat mixed), the maggot will attack the Oats and leave the Barley."

At the same date I also received information, from Launceston, that much of the Oat-crop in that neighbourhood was badly affected, like specimen sent, and information was urgently requested, "as in the district of Launceston we are likely to get half our crop destroyed."
—E. J.

On June 29th a communication was forwarded me, on the part of Mr. Thos. Olver, of Truro, mentioning that there was a disease affecting the Oat-crop in the district, which in many instances threatened to destroy the whole crop, the cause of which was clearly an insect."

In these specimens I found the small white maggot, and also the pale brown, recently-formed chrysalis of an *Oscinis*, which, by rearing from various specimens, afterwards showed the attack to be of *O. frit*, the true Frit Fly.

At first I had great difficulty in identification of the attack, owing to the plants being often much dried in transmission, and also from the very small size of the white maggot, even if present in the stems, which in many cases it was not, as the maggots were then leaving the destroyed shoot to turn to chrysalids in the sheathing-leaves. I had therefore to judge of these specimens being damaged by "Frit Fly" from the resemblance in all points noticeable to specimens, of which only too many unfortunately a little later proved Frit Fly presence with certainty.

On July 2nd, Mr. Geo. Thomas, writing again from Scorrier, mentioned that he could not since the date (June 27th), when he had forwarded specimens with maggots in them, been able to find any. Rain had fallen, and Mr. Thomas observed:—"I have twenty acres of Oats now recovering; that means the maggot has stopped, and the attacked plants are now recovering, sending forth fresh shoots." May I suggest (say) 5 cwt. wet sea-sand, 8 cwt. salt, $\frac{1}{2}$ cwt. sulphur, to be sown per acre broadcast in rain or on a dew? If the land is poor, a little of Norrington's "Nitro" would be a great advantage.

Mr. Thomas also forwarded a note from the 'Western Morning News' of Saturday, June 30th, mentioning the fear that prevailed that the Oat-crops in N. Devon would prove a failure. The crops were reported to have then a yellow seared appearance from the number of dead stalks, and the destruction to be owing to a small white maggot secreted in the very heart of the stalk. This had been found, after

careful examination, by Mr. Thomas Andrew (a considerable farmer, residing in the parish of Clovelly).

On June 30th, I had specimens of chrysalis of Frit Fly from Allerford, near Taunton, Somerset. So far as was generally observable, the appearance of the pest in South Devon seems to have been just a little later, for, on July 2nd, I received specimens of injured Oats and small brown chrysalids of the Frit Fly from Mr. R. R. Velvin, of Upton Farm, Ivybridge, S. Devon, with a note that they were taken from a field of what at one time promised a splendid crop. "They were attacked in this way about a month ago, and now quite half of them are like the enclosed. I may say they are all over the field just alike. I see by the newspaper that the Oat-crop in N. Devon has been very generally attacked in a similar way, but, as far as I can hear, mine is a solitary case in this neighbourhood."

A few days later,—that is, on July 2nd,—I had a report from Mr. John Bulteel, of Painflete, Ivybridge (S. Devon), showing that the Frit Fly attack had then become noticeable. He said :—" Nothing could have been more luxuriant than our Oat-crop at an early stage, but at present the whole aspect has changed, the fields being one mass of patches, getting worse and worse daily. I presume the crop is suffering in the same way as is going on in the north of Devon."

Specimens of diseased Oat-plants were sent with the white maggots, and some chrysalids, but the change from one condition to the other was now going on so rapidly, that when I received them all were in chrysalis condition. The plants were stunted in growth by the attack, and one had as many as twelve spindly shoots, some of them killed.

On July 8th a note was sent from Treluddra, Newlyn East, of the great destruction made on the Oat-crop in that part of Cornwall by what proved, from specimens sent, to be the same attack.

On July 17th I was favoured with a complete set of specimens, including maggot, chrysalis, and perfect Frit Fly, sent me from Bodmin by Mr. Richard V. Tellan. He remarked :—" A great deal of damage has been done this season to the Oat-crop in this district by a small insect, which has destroyed the young panicle before it has had time to develop. I should suppose that the egg was deposited as soon as the stalk began to spring from the roots." Mr. Tellan mentioned, with regard to the specimens enclosed, that he forwarded " the perfect insect and pupa " (chrysalis). " The insect was developed from the pupa in the glass tube, where I had placed them. They were taken from under the sheath of the Oat-straw. There is a single specimen of the larva (living) in the tube. Most of them had changed to the pupa-state before my attention was called to them."

The above communication is very valuable, as it gives the pest in all its stages of maggot, chrysalis, and perfect fly, and thus proves,

besides what was reared from other specimens, that the fly, which on examination was identified as the true Frit Fly, *Oscinis frit*, was the cause of the widespread loss.

The following communication from Tregaswith, St. Columb, Cornwall, is also valuable, as showing how, throughout a district, the crop showed no sign of what was going on till the mischief was done. Mr. James Stick, jun., observed:—"I am one of a great number of farmers who are suffering in this district through the failure of spring corn, chiefly Oats. The crop came up, and looked well until the latter part of May, when it appeared to be checked in its growing, and gradually wasted away, until what promised to be a heavy crop will only be a third. I have found, on examining the stalk, a very small maggot, one-eighth of an inch in length, in the centre of the straw."

The above notes refer to the Oat-attack in the South-west of England, in various localities from Taunton in Somerset to the western extremity of Cornwall. Besides the above, I had notes of the attack from near Reading, from Tetsworth, Oxon, from Cirencester, and also from a locality in Kent, and from Oakley, near Bedford.

On July 2nd, Mr. John Watson, writing from the Estate Office, Sherburn, Tetsworth, forwarded a plant of Oats as a sample of the condition of one field, with the mention that he had found about ten larvæ and pupæ in each of the plants which he had examined. He observed:—"The Oats were drilled about the middle of April on part of a field after roots fed off by sheep, the other part of the field being planted with Barley, which does not appear to have been attacked. . . . I may mention that the field is subject to annual attacks of 'wild' oats. Several pieces of Oats in this neighbourhood have partially failed, apparently in the same way, but I have not been able to examine them closely. I do not think the crops sufficiently injured to make me plough it up, and I suppose we cannot do anything now to prevent further damage."

The plants sent were mostly still of a good green, and from about two or three to four inches high, but had some pale, long, straggling shoots. The chrysalids, which were similar to the other specimens of *Oscinis frit* that were sent from many localities, were in the partly-decayed leaf-sheaths round the base of the small shoots. A few days after,—that is, on July 2nd,—Mr. Watson wrote further to mention that they had decided to leave the Oats alone, "as the last few days of warm showery weather have much improved them, and the larvæ have almost all changed."

On July 4th, Mr. Harker, Professor of Zoology at the Royal Agricultural College, Cirencester, wrote me that specimens had been shown him of Oat-stems infested by a small dipteran in the pupa-state, which, from microscopical examination, he conjectured would

prove to be *Oscinis*; and a few days later (on July 7th) he further wrote that he had then "larvæ, pupæ, and, I think, two imagines," and he considered the larvæ appeared to correspond with that of *Oscinis vastator* of Curtis, which remark is of a good deal of interest, as confirming the opinion of Dr. E. L. Taschenberg that the Frit Fly, the *Oscinis frit* (which our English specimens proved to be when the perfect fly developed) and the *Oscinis vastator* of Curtis are the same species.

Regarding amount of attack, Mr. W. McCracken, Professor of Agriculture, Royal Agricultural College, Cirencester, kindly favoured me, on July 4th, with the following useful note:—"I send you a few specimens of Oat affected by a small grub. I am sorry to say a very large area in this part of the country has suffered similarly. The crop from which these specimens are taken is practically destroyed, except for hay. Winter Oats and all early spring-sown fields seem to have escaped." And a few days later Prof. Harker wrote further on this point:—"Since writing you we have examined a field of Oats quite near to the College. The damage is quite appalling; Mr. McCracken roughly estimates 90 per cent. of crop gone."

The last report of damages which I received, with specimens in maggot and chrysalis-state accompanying, was forwarded to me, on July 9th and 12th, by Mr. W. Gostling, from Oakley, Bedford, with the observation that the maggot had injured several crops of Black Tartarian Oats in that neighbourhood. Likewise, that the whole of his own Oats—some sixty acres—were injured in a greater or less degree, although he had applied 10 cwt. of soot per acre to some, and 1½ cwt. of nitrate of soda to the rest in the early stage of growth. The plants forwarded were of a good green colour, and from about four to seven inches in height of shoot, but inside they were destroyed by the maggots. In some instances traces of the working, or even the maggot itself, was to be found in the forming (or what should have been the forming) stem at from three-quarters of an inch to an inch and a half from the surface of the ground. The peculiar branched spiracles were very noticeable. Chrysalids were present, similar in appearance to other specimens which I received of those of Frit Fly, as well as maggots.

Summary.—As injury from Frit Fly attack appears to be unusual in this country to the amount to which it occurred last year, a short summary of the above observations may be useful. Looking at the geographical distribution of the attack (so far as appears from the notes sent to me), it seems to have been most prevalent in Devon and Cornwall. It was reported from the neighbourhoods of Launceston, Bodmin, St. Columb, and Truro; from Scorrier, between Truro and Redruth; and also from Newlyn East, near Penzance, in Cornwall.

It was also reported from both North and South Devon, and from Taunton, in Somersetshire. More inland, I had notices of it from the neighbourhoods of Cirencester, Reading, Tetworth, and Oakley, near Bedford; and, later on, specimens of the injury caused by it to Oats near Norwich.

It will be observed that in the case of the greater part of the attacks reported, that they were mentioned as occurring not merely to special fields, but over districts, or neighbourhoods, or that many farmers in the neighbourhood written from were suffering: near Launceston it was feared half the crop would be destroyed; another note from the neighbourhood of St. Columb mentioned that the crop, which promised to be heavy, would only be a third; and in a rather more detailed observation, with which I was favoured from the Royal Agricultural College, Cirencester, it was mentioned by Mr. McCracken, Professor of Agriculture, that a large area in that part of the country had suffered, and he roughly estimated the loss on one field near the College at 90 per cent. The first notice of something being amiss with the plants appears to have been taken about the end of May. One observation notes that the crops came up and looked well until the latter part of May, when growth appeared to be checked; another, that the injury was first noticed about the beginning of June, with special mention of the rapid change in appearance of the maggot-gnawed plants from their previously healthy or even luxuriant condition; and another observer reports the injury being first observed when the crop was from a foot to eighteen inches high.

About June 27th the maggots were turning to chrysalids amongst the outer leafage of the destroyed shoots, and towards July 9th, Frit Flies were appearing from the chrysalids. So far as appeared the attack only affected Oat-plants, and notably, not Barley-plants. It was noted in one case as "a peculiar fact that in 'dredge-corn' (i. e., Barley and Oats mixed), the maggot will attack the Oats and leave the Barley": in another instance mention was made of the damage being "on Oats drilled about the middle of April, . . . the other part of the field being planted with Barley, which does not appear to have been attacked."

Relatively to time of sowing of attacked crops, alluded to above, I had very few observations; but it was noted by Prof. McCracken, in his letter from the Royal Agricultural College, that "Winter Oats and all early spring-sown fields seem to have escaped."

From reports sent in autumn, it appeared that in some instances the attacked Oat-crops recovered partially. In the words of one observer:—"The crop of Oats has proved heavier than was expected at one time. The wet weather was favourable to the growth of the straw, so the side-shoots came to maturity, though generally very

late, and the crop ripened very unequally with very varying sample." —(R. V. T.). This unevenness in ripening was specially reported from other localities.

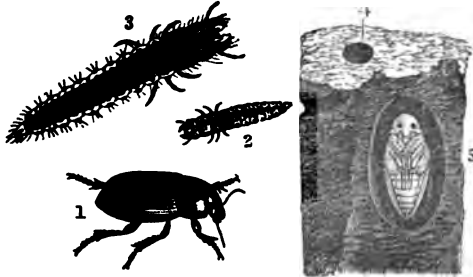
Looking at the point of bad Frit Fly attack being unknown before in this country, and that in Sweden and Bohemia respectively the maggots of the summer brood have been found feeding in ears of Barley, and amongst the grains in the Oat-heads, it appeared possible that the infestation might have been brought in foreign corn; but replies to enquiries did not bear this out. Information was given me that there was large importation of Swedish Oats into Bristol, from whence they are widely distributed; and a small quantity of Swedish Oats were sown near Bodmin in one instance, and conjecturally more, but there was no evidence given as to imported seed having been used where infestation occurred. The correspondents who favoured me with replies on the subject had used seed either home-grown or imported from Ireland.

Nevertheless, though as yet we have not had the summer attack in the Barley or Oat-ears reported in England, it might be worth consideration whether "pickling" seed before sowing would not be desirable, so as to guard against possibility of carrying eggs or chrysalids, which might furnish flies to renew attack, in it to the field. One means of probably lessening amount of loss is suggested by a remark in some of the foregoing observations. It is mentioned that, after the maggots turned to chrysalis-state, attacked plants (which had not been destroyed past all hope) threw out shoots, so that a crop was obtained, although, from inequality of ripening, it was very far from what was desirable. From this it would seem that, if a dressing of whatever nature was suitable to the kind of land, and also to Oat-crop generally, was given early in the attack, this would push on the uninjured shoot in time to give a fairly equal crop.

From the reports it appears that, if the growth had been brought about earlier, the damage would not have in some cases been great, and consequently that, if a stimulating dressing could be applied when the damage is *first beginning* to show, time enough in growth would be saved to have an even crop. When the damage is noticeable, the maggots that cause it have grown to such a size that it shows that the time of laying the eggs from which they were hatched has long been over, and that what shoots are not then infested will be safe. The nature of the dressing will be best judged of by agriculturists themselves; but in a series of experiments on Oats (noted further on under the head of "Tulip-root"), it has been found now for some years that sulphate of potash, or a mixture of sulphate of potash with sulphate of ammonia and phosphates, answer exceedingly well in bringing on a healthy crop.

Where it is possible, a rotation of crop which would leave out Oats for a while in the badly-infested districts, would be the surest method of all to prevent continuance of attack.

Corn Ground-beetle. (? *Zabrus gibbus*, Fab.)



ZABRUS GIBBUS.

1, beetle; 2, 3, grub, nat. size and magnified; 4, mouth of underground burrow of grub; 5, chrysalis.

The *Zabrus gibbus*, or gibbous "Corn Ground-beetle," does harm in both beetle and maggot-state. The beetle comes out at night, and, crawling up to the top of the corn-stems, eats the grain in the ears: the maggot feeds below ground, or near the surface on the young plant. Wheat, Rye, and Barley are recorded as being attacked on the Continent, but, although this species has been observed in various places in England, it was noted up to 1859 as *not* having been ascertained to have attacked the crops in England as it did on the Continent, and up to the past season I am not aware of it having done so. Then,—that is, about the end of January,—a beetle-grub was found to be doing great mischief to young Wheat-plants, something in the same way as wireworms, but variously described; sometimes the grubs were inside, sometimes they cut the plant through, and in one case I found the outer part frayed, as if chewed to pieces. Later on I had a note of the attacked Wheat appearing "*worried to death*," not cut off absolutely, which agrees with the excellent description by Dr. Taschenberg.

The beetle-grubs sent resembled the descriptions of those of the *Zabrus gibbus* very minutely, but I could not identify them with certainty, for if so, they were not nearly full-sized nor fully coloured. Still, after consultation, it appeared so unlikely that the grubs were of any other kind, that it seems desirable to give as much information as I could obtain, for reference in case of continuation of the attack.

The localities where most harm was done were in Hants, in the district of Lymington, and near Ryde, in the Isle of Wight. I had

also notes from Harlington, Middlesex; from near Bishop's Teignton, S. Devon; from near Ipswich; and I had also specimens brought me from a field near St. Albans. It is of some interest, in connection with the three first-named localities, to note that John Curtis mentions, in his 'Farm Insects,' p. 217, that he himself saw or was aware of the presence of the beetle in Hants, and the Isle of Wight, and near London, as well as in Norfolk and Kent.

The first communication I received on the subject of this beetle-grub was at the end of January, from Mr. Robert Newman, of the Church Farm, Harlington, Middlesex, accompanied by specimens of the grub, still too young to be fully coloured, and also a few blades of the injured corn. He observed:—"The smallest of them I found eating into the stalk; others were loose in the land."

On Feb. 7th, Mr. Edw. Carter reported, from Puckpool House, Ryde, Isle of Wight, with similar specimens accompanying:—"I send some grubs that are eating my Wheat; they have almost entirely destroyed three or four acres of Wheat of a tenant of mine,—oddly, they have attacked his red Wheat, but not his white, in the same field. I also send some plants that have been killed by the grubs."

In this case the plants were bitten through, or, in one instance, the outer leaf frayed out into long films.

On Feb. 11th, specimens of grubs damaging Wheat after "bent" were brought me from New House Farm, near St. Albans, by Mr. W. A. Dickinson. These beetle-grubs appeared like those from Harlington, and from near Ryde, excepting that they were darker. I placed them, and some from near Ryde, on turf in a flower-pot, and in a short time they all disappeared; some of them went down at once in the damp ground. About ten days later Mr. Dickinson called again with a few more specimens of the larvæ. He mentioned that almost the whole of the Wheat was destroyed, and they were ploughing it up. Also that there were few grubs now to be seen, but that the Wagtails followed the plough in such numbers, he thought most likely they were clearing these grubs away.

The two following letters, forwarded to me by the Editor of the 'Mark Lane Express' for reply (and which I give through his courtesy), are of much interest. It will be observed that they speak of the attack as being of a serious nature, and extending over some miles of country, and also of it not having been previously observed.

The following communication was sent by Mr. Geo. Marsh, from The Home Farm, East End, Lymington, on Feb. 15th, 1888:—

"I have enclosed two specimens of maggots, or small worms, found about 1½ in. deep in our Wheat-fields in this locality. As none of us here are able to identify them, it occurred to me that perhaps you could afford some information respecting them. Acres and acres

of young Wheat in this neighbourhood are seriously damaged, if not destroyed, by being bitten off in the soil; and, as far as I can make it out myself, the mischief is effected by the small brown worms, two of which I have sent in the box. The small white maggot was also found in the same position, and may also have had a share in the mischief. The brown ones are sometimes found partly inside the stalks, as if sucking the juices of the plant. As the effect will, I fear, be very disastrous, I thought it a matter of sufficient consequence to bring to your notice."

The following note, referring to the widespread injury caused by the grub, was sent from Winchester, on Feb. 16th, by Mr. J. Gill Comely:—

"An immense number of the worms, of which I take the liberty of sending you a few specimens, having appeared in the Wheat-plant in nearly all the land extending from Lymington to Beaulieu, and threatening to destroy the same, I venture to send a small box containing the same, and with hopes that you may be enabled (probably through Miss Ormerod) to inform me what is their name, and whether you are aware of any means by which their ravages can be either stopped or checked; as otherwise they will have to be ploughed in, but with full expectation of appearing again in the following crop of whatever character. The appearance in the Wheat is the same as from the effect of Wireworm, but of which we do not find any; and it is the same, whether manured with farmyard-dung or any other manure. We have ring-rolled and heavily pressed the land, but only a few of them have been destroyed."

The specimens sent with the two preceding letters were certainly beetle-grubs, and of the class of ground-beetles (scientifically *Geodaphnagous larvæ*), and so much resembled those of the *Zabrus gibbus*, the Corn Ground-beetle, that it appeared almost impossible that they should be of any other kind; but as the *Z. gibbus* grub, when full-grown, is somewhat more than an inch in length, and the specimens sent me were then only about a quarter of an inch long, and (apparently from immaturity) still not fully coloured, they could not be identified with absolute certainty.

The specimens I examined were long and narrow, lessening in width towards the tail, and with chestnut-brown heads, and with strong sickle-shaped jaws, toothed within. Above, there was a mark like a depression from back to front on each side of the centre of the upper part of the head. The three succeeding segments were brown and of horn-like appearance above (the segment nearest the head being the longest). These three segments are each furnished with a pair of jointed legs, terminating in a point or claw. The following segments had a dark transverse patch on each above, divided into two parts by

a light line running down the middle of the back,* and beneath this transverse divided patch, on the side of each segment, there were two spots: all the segments, excepting that next to the head and the tail-segment, were of about one length, this being less than their breadth. The caudal segment was furnished above with two tubercular or spiny processes, and beneath with a sucker-like protuberance. The general colour of the grub, excepting in the patches, was whitish, and there were a few good-sized bristles on the body.

As it is next to impossible to identify an immature grub without personal knowledge of the kind, I ventured to write to Dr. E. L. Taschenberg, of Halle, Germany, as one of the highest authorities on Economic Entomology, and likewise as having especially studied and described the attack, as well as the larva, of the *Zabrus gibbus*. He was good enough to examine my specimen (which I had sent on a microscope-slide with a covering-glass over it), and replied to me that in the form of the fore part of the body, as displayed, and likewise the method in which the grub injured the young Wheat, it differed from that of *Z. gibbus*; but the arrangement of the plate on the back ("Chitin-shield"), and the form of the extremity of the body, exactly corresponded.

Dr. Taschenberg considered that the pressure of the covering-glass might account for the fore part of the body being somewhat altered in shape, and the method of life of the young larvæ might not be precisely the same as when full-grown; consequently he inclined to think my specimen was of immature *Zabrus gibbus* larva, but before speaking with certainty he wished for full-grown specimens. These, however, I was never fortunate enough to procure; but as this grub, unless killed, lives for three years, it may re-appear again on some of the infested localities, and if so, I should be glad of further specimens for identification.

Dr. Taschenberg was good enough to give me a type-specimen; therefore, I should hope to have no difficulty in identifying fully-developed samples.

The figures 2 and 8 at the head of this paper show the appearance of the larva. The habit of life is stated to be for the grub to go down beneath the surface of the ground in the day, and in the evening or night to feed on the young plant.

It is mentioned by Kollar that it eats into the stem at the surface of the earth, "and revels in the pith within." Dr. Taschenberg, in his more detailed description, notes that, from the small size of the mouth-opening, the grub lives rather by crushing the plant and

* It is noted by Dr. Taschenberg that after death the larva appears to have the stripe along its back uninterrupted, and this I notice to be the case here.

drawing in the juices than by biting it through. When about to turn to pupa they are stated to make long burrows from six inches to two feet in the ground with a cell at the end, in which they turn to the pupal or chrysalis-state, from which the beetle comes out (in about three or four weeks) about the beginning of July. The beetle is of the size and appearance figured, and of a black or blackish-brown colour.*

Later on further reports were sent of the damage caused by the same kind of grub.

At the beginning of April, Mr. W. S. Reading forwarded specimens from Shirley, Ringwood, Hants, as samples of a kind that was destroying the Wheat-crop in that neighbourhood. He mentioned:—"It appears to eat the stalk away down to the root, leaving nothing save a blade here and there. One farmer has ploughed up about twelve acres; another has some acres that are eaten pretty bare, but he notices this morning that a good many of the roots are putting up new shoots, so he has decided to let it remain awhile."

A few days later, Mr. Reading wrote further, mentioning that his neighbour thought that "he would have done well to have dressed the land about Christmas-time, when he first noticed the injury the grub was doing"; and that at the time it had disappeared.

At the above date,—that is, April 9th,—a communication was also sent me from Akenham, near Ipswich, by Mr. J. A. Smith, who mentioned that the Wheat in his neighbourhood was going off terribly where it succeeded Clover and Rye-grass, but not after Peas and Beans. Specimens of millepedes, and of various insects in grub-state, were sent accompanying, and amongst these were grubs of the same kind as those above alluded to (that is, apparently, of *Z. gibbus*), one of these being more advanced in growth than any previously forwarded; and in his notes Mr. J. A. Smith said that "the Wheat seems *worried to death*," not cut off absolutely. This remark is of considerable importance, as the crushing or chewing rather than biting off of the plant is one of the characteristics of the attack of the *Z. gibbus* grub.

From the different observations sent in, it is plain that much damage was done in various localities by the grub of a ground-beetle, of a kind which had not previously been noticed as destructive; but from the different methods of attack reported, and also the different kinds of pests sent accompanying, I do not attribute the whole of the damage to this special grub.

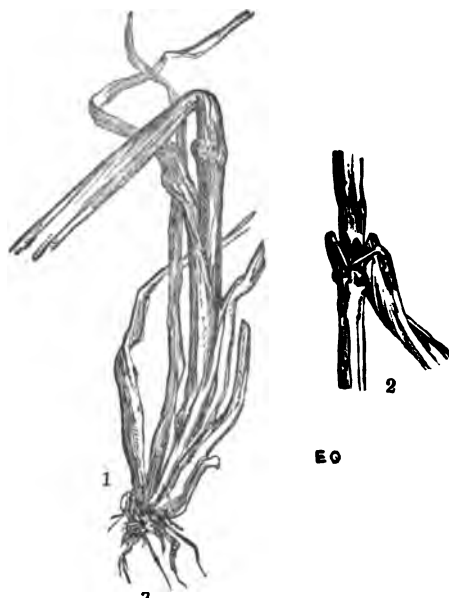
But whether it was the Corn Ground-beetle grub (as is possible), or the grub of another kind of ground-beetle not yet described, probably

* The above description is from Vincent Kollar's work on 'Inj. Insects,' Eng. trans., pp. 88—90. Those who wish to study the subject at length will find it excellently treated on in the 'Praktische Insekten Kunde' of Dr. E. L. Taschenberg, pt. ii., pp. 2—7, with minute description of larva.

no better remedy could be found than that applied by Mr. Dickinson, as mentioned at p. 44, of ploughing up the destroyed crop. Thus, throwing the grubs out to birds and weather influences, and likewise, in all reasonable probability, to *eating each other* for lack of the crop-food, would be measures likely to act extremely well.

It is earnestly to be desired that those whose crops suffered in the past season will be good enough to watch for any re-appearance of the attack, and, if it occurs, I should be greatly obliged by specimens which would enable me to identify it beyond doubt.

Hessian Fly. *Cecidomyia destructor*, Say.



Barley-stem injured by Hessian Fly maggot; 1, "elbowed" down; 2, showing the "flax-seeds."

So far as appears from the reports sent to myself during last summer regarding attacks of Hessian Fly, there has been a most marked and satisfactory decrease on the amount of presence of this pest compared to what it was in the preceding year. In 1887 it was reported (with specimens accompanying, or by contributors well conversant with the attack) from more than 72 localities in England, and about 20 in Scotland, these centres often representing districts and sometimes many miles of area of attack. This year only about six reports have been sent me, with specimens accompanying, and of these only one mentions the attack as being prevalent in the district; the

others only refer to it as respectively on single fields or on a farm. I believe attack was reliably reported in one or two other localities, but specimens were not sent me.

Doubtless other attacks may have occurred and not been mentioned at the time ; as, for instance, while writing this, on Dec. 26th, I have received the following note from Mr. Eardley Mason, of the Sycamores, Alford, Lincolnshire :—“ The Hessian Fly I find to be generally distributed in both Wheat and Barley in this district, *i. e.*, within a six miles' radius of Alford ; but the damage has not, in Wheat-crops, been appreciable, and in the Barley-crops not much of a measurable quantity.

On July 8rd Mr. Geo. Palmer, of Revell's Hall, near Hertford (the first observer of Hessian Fly in this country), forwarded some stalks of Barley infested by this pest, then in maggot condition, with the observation that the large amount of rain which had lately fallen had made the straw very weak, and a great number of the stalks were broken down from the second joint, and in nearly every instance these contained larvæ of the fly.

On July 4th puparia were sent on Wheat-stems (with the information that they were found on Wheat as well as on Barley) by Mr. F. O. Palmer, from Hale St. Nicholas, near Westgate-on-Sea, Kent ; and on July 7th a Hessian Fly puparium, from which the contents had emerged, was sent me by Mr. J. Eardley Mason, of the Sycamores, Alford, from a farm in the next parish.

The only information sent of Hessian Fly infestation occurring to any great extent was forwarded to me, on July 8th, from Temple Court, Clandon Park, Guildford, by Mr. G. P. Smithson. In this case specimens both of the maggots and puparia (or “ flax-seeds ”) were sent. Some of the maggots were still white, or white with the green juice on which they feed showing through the somewhat transparent skin. Mr. Smithson mentioned that he had found the attack present in most of the Wheat and Barley fields in the neighbourhood of Guildford within the preceding few days, some being in the larva, some in the pupa-state ; and further observed that this year he had found every specimen to be at the first knot. Last year—that is, in 1887—he had found that in Wiltshire, also in the Richmond district of Yorkshire, and about Inverness, they were, as a rule, at the 2nd, but more often at the 8rd than the 1st knot. This he considered was most likely, because of late sowing, so that the second knot was not sufficiently developed when the fly laid her eggs.

The fifth report of presence of Hessian Fly attack was sent me, on July 14th, from Birchmoor, Woburn, by Mr. Edw. Blundell, with specimens of “ flax-seeds ” accompanying, taken from a Wheat-field, and the observation, “ as there are a great many stalks broken, I have

but little doubt that the fly is abundant. I hardly expected to find the 'flax-seed' thus early, as the Wheat is so green and late this year." The specimens sent were on green Wheat-stems, which were thoroughly bent at the spot where the maggots had lain and fed.

The only other note of attack which I received was sent me somewhat later in the season—on Sept. 1st—from Lower Abbey Farm, Leiston, Suffolk, by Mr. A. M. Rosse. In this case it was a twelve-acre field of Barley that was infested, and the "flax-seeds," of which specimens were forwarded, lay at the 2nd knot of the straws. For some time previous the straws had appeared to leave off growing and dwindle away; the crop had promised very well in June and the early part of July, but was then a good deal laid by the heavy rains, so that it was difficult to say how much of the damage was to be attributed to the insect-presence. He had not observed the "flax-seeds" until the preceding day, and then, though there were many imperfect stems of Barley on almost every root (some with a few grains, and many with none, and most of them broken down), he only found four or five of the puparia or "flax-seeds" after searching a good while.

The above six notes were the only observations which I received of Hessian Fly presence last season. Of course the attack may very possibly have occurred in many places without any mention of it being sent to myself, but still, as it was not reported, and very little mention of it was made in the agricultural journals, save, as far as I am aware, one note (somewhat generally expressed), that it was all over one of the southern counties, I think there is great reason to hope that there has been a most satisfactory decrease of presence of the pest.

The points of prevention cannot be too strongly insisted on still, which have been before mentioned, and which are approved by the leading agricultural and practical entomological authorities in other Hessian Fly-infested countries. One of these is to sow Wheat no earlier *than is usually* the case in this country. In America it is called late sowing; but here sowing after September may be fairly expected to put the appearance of the young Wheat quite safely after the time when the Hessian Fly of the summer brood are abroad for egg-laying. Thus, so far we have escaped the winter attack to the young plant, which is a most important matter, and, in fact, at once saves half (and what, I am informed by Prof. Riley, Entomologist of the Department of Agriculture, U. S. A.), is considered the most important half, of the year's mischief caused by this pest. Another great point in prevention is destroying the light screenings from infested corn. These are of no value, being chiefly of dust, small weed-seeds, and the like; and, being thrown down together by the threshing-machines, there is little difficulty or expense in gathering them up and destroying them. If it

is troublesome to burn them, they may be thoroughly mixed in wet manure. If the "flax-seeds" in the rubbish are thus destroyed, there is an end of all damage from them; but if they are left,—thrown aside in any odd corner,—the Hessian Flies will come out just as the common British Wheat Midges will come out (as I have myself seen) in legions from heaps of chaff-rubbish; and in the two cases respectively, attack of Hessian Fly maggot, or of our common red maggot, will be the consequence of allowing the two sorts of Wheat-midge to go free. In this respect preventive treatment for *Cecidomyia destructor* and *C. tritici* are just the same.

Screenings and cleanings from imported corn, especially from Wheat or Barley imported from Russia or Eastern Europe, or any country infested by Hessian Fly, are to be looked on with great suspicion; this not only on account of the Hessian Fly chrysalids or "flax-seeds" which may be in them, but also because of the other kinds of injurious insect-attack which are extremely likely to be found in the short bits of broken straw, or are certainly found in injured grain or rubbish; and likewise on account of the weed-seeds, ergot, and other noxious pests, which are thus transported amongst us consequently on the grain being sent foul, and in some cases apparently deteriorated in quality purposely before shipping to this country.

Rotation of crops and other means of preventing the Hessian Fly establishing itself, and of lessening the amount of mischief where it gains possession, have been already previously given; but observations with which I have been favoured by Dr. C. Lindeman, of Moscow, during the past season point to the importance of clearing the surface-rubbish of infested fields as thoroughly as can be done. There has been doubt and difference of opinion as to the kinds of wild grasses which were liable to infestation by Hessian Fly, but during the past season Dr. C. Lindeman has been good enough to send me information of "Timothy-grass," *Phleum pratense*, having been found during 1887 in one of the Russian Governments (that of Tambov) to be severely attacked by Hessian Fly, in corroboration of which many specimens of Hessian Fly puparia were sent to him.

In 1887 also Dr. Lindeman received specimens of stems of couch-grass (*Triticum repens*) sent from the Government of Tambov, and that of Woronetz, which were elbowed-down by, and infested by, puparia of the Hessian Fly; and communication was made to him at the same time that the couch-grass was so severely attacked, that in whole districts covered with this grass it was destroyed.*

We have not as yet had reports of the Hessian Fly being observed

* Leaflet on das Vorkommen der Hessianfliege an wildwachsenden Gräsern. Berlin: B. Friedlander.

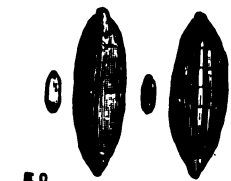
on the above grasses in Britain, but the fact that the "flax-seeds" may be there is another reason for at least doing all that can be done to clear the surface of infested fields. Skimming, and dragging the stubble and rubbish together and burning it, would get rid of some amount of "flax-seeds" which had not yet developed their contents, and also of some couch-grass which might have served as a nursery in that autumn, or in the following season; and ploughing with a skim-coulter, so arranged as thoroughly to bury down the skimmed upper surface, is a well-known preventive of attack.



CECIDOMYIA DESTRUCTOR, Say.

Hessian Fly, natural size and magnified.

Full description of the Hessian Fly in its various stages, and also of the method of the injury and appearance of the injured straw, has been so often given, that it is unnecessary to repeat them again at length here; but the reader is referred to the accompanying figures for requisite representation. These show (at page 48) the shape, size, and position above a joint (usually the 2nd joint from the ground) of the *puparium*, or chrysalis-case, commonly known as the "flax-seed"; also the method in which the straw elbows down above the injured part, which is weakened by the sucking of the maggot at one spot.



Puparia or "flax-seeds" in different stages.

The maggot is legless, whitish (with sometimes a little green tint from the coloured juice on which it feeds showing through the skin), and in shape resembles the so-called "flax-seed," to which it presently turns. This gradually becomes of a deep chestnut-brown, and towards the time of maturity is striated longitudinally with fine ridges and furrows, as figured. The fly may be generally described as looking like a little brown gnat, about one-eighth of an inch in length, with one pair of smoky-grey wings.

For full technical description of the Hessian Fly in imago, or perfect condition, the reader is referred to the fully-detailed account given by Mr. R. H. Meade, of Bradford, from examination of living

specimens, published in the 'Entomologist' for July, 1887 (West, Newman & Co., 54, Hatton Garden); and for accounts of the attacks of Hessian Fly in this country, and means of prevention and remedy, I may refer to my own Reports on 'The Hessian Fly in Great Britain, 1886,' and 'The Hessian Fly in Great Britain, 1887,' published by Simpkin, Marshall & Co., Stationers' Hall Court, London, E.C.

Ribbon-footed Corn Fly; "Gout." *Chlorops taniopus*, Curtis.

During the past season attack of "gout,"—that is, of injury caused by the maggot of the Ribbon-footed Corn Fly,—was not much reported on, and, as this attack has been very fully entered on in previous years, I merely just mention it now, with a figure of an ear and stem of barley showing damage caused by the maggot, and a short description of the nature of the attack.

The fly (see figure in previous Reports)* is a thick-made, small, two-winged fly, black and yellow in colour, the body between the wings being very observably striped lengthways with black on a yellow ground.

The fly lays her eggs whilst the young Barley-plant, in early summer, is still young and tender, and the maggot hatching out of the egg attacks the forming ear at the base, or more or less above it, and then gnaws its way down one side of the stem within the sheath down to the uppermost knot. The consequence of this is that part of the ear is injured, and the stem often so checked in its growth that it is dwarfed, and also the ear is unable to free itself from the sheath, and the plant altogether acquires a swollen, unnatural form; whence the name of "gout" has been given to the attack.

The figure shows a common amount of injury, in which the ear is a little damaged and the stem (which is sketched with the sheath torn away so as to show the black furrow gnawed down it by the maggot) is a little distorted.



Stem of Barley attacked by *Chlorops*;

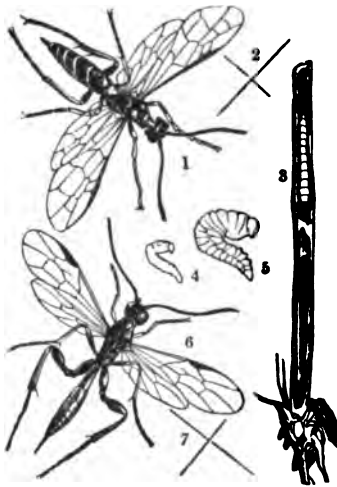
* See Ninth and Eleventh Reports on Injurious Insects.

The maggot turns to a small brown chrysalis on the injured stem beneath the sheathing-leaf. From these chrysalids the flies come out in autumn, and sometimes may be found in vast numbers in newly-stacked Barley.

From German observations it appears that the flies lay their eggs in the young autumn-corn plant, and in these the maggots feed, the flies from these coming out at the right season to start the summer attack on the growing corn, as mentioned above.

We much need more observations as to where the winter brood lives in the country, as it is this which mainly keeps up the pest to attack the summer crops. We should then know how to check attack. At present, as we do not know of its presence till the mischief is begun, but little can be done in the way of prevention.

Corn Sawfly. *Cephus pygmaeus*, Curtis,



CEPHUS PYGMEUS.

1, 2, Sawfly, with nat. size ; 3, stem containing maggot ; 4, 5, maggot, nat. size and mag. ; 6, 7, parasite fly, *Pachymerus calceator*, mag., with nat. size.

Some amount of attack of Corn Sawfly occurred last year, but not enough to require any very special mention, as the subject has often been entered on before in these Reports.

The fly is of the shape figured above, with four wings, and of a yellow colour banded with black. The injuries it gives rise to may be easily known by looking within the attacked straw. Here the small legless, or almost legless, pale yellowish-coloured maggot, with its pale brown head armed with minute jaws, will be found feeding within the

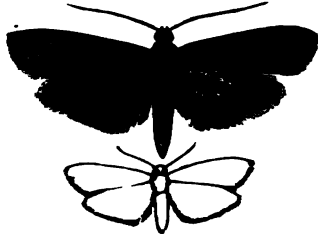
tube, which is often partly filled with maggot-dirt. It makes its way along the whole of the inside of the straw by cutting a passage through the knots, and about harvest-time, when it is full-grown, it goes down the straw (always inside) to ground-level. There, with its jaws, it bites a ring round the straw (on the inside), so that presently the straw breaks and falls; but the maggot lies secure in the short stump of stubble remaining in the ground, where it protects itself for the winter by spinning a covering, in which presently it changes to the chrysalis-state, from which the sawfly comes out early in the following summer.

Much damage is sometimes caused by the attack, as the maggot gnawing within the straw injures the progress of the ear, and when the straw at last falls, this, of course, is hurtful to the harvest.

Nothing at all can be done when attack is set up to remedy it, but recurrence (from obvious infestation) may be prevented by scuffling the surface, and dragging the stubble together and burning it. Ploughing the stubble under will destroy the maggot within, or at least prevent it coming to maturity and spreading infestation, if the stubble is well covered down, and not turned up again until July of the following year, when the time for the flies to come out is past; but as this is difficult to ensure, the simplest and safest plan is collecting the stubble and burning it.

SCREENINGS.

Corn and Flour Insects, &c.



EPHESTIA KUEHNIELLA.

Flour Moth, magnified; outline showing nat. size.

In the summer of 1886, when Hessian Fly attack first appeared in this country, one of the first ideas connected with it was—how and whence did it come? Imported straw was obviously a possible means of transmission, but long watch carried on in the most careful manner at various ports failed to show presence of more than a single “flax-seed” (that is, chrysalis of the Hessian Fly), this adhering to a straw from Belgium.

Another possible method of introduction was transmission in chaff and rubbish from foul corn imports, and this probability was greatly strengthened when we found that the “flax-seeds” were detached from the straw in great numbers by our threshing-machines, and that, in the process of cleaning the corn, these “flax-seeds,” or chrysalids, were thrown down with the light weed-seeds and rubbish. We thus learnt that they *could* be detached, and thus we arrive at the point that where corn is sent over foul, with the chaff, dust, rubbish, &c. still in it, to the amount to which it often comes, that it is highly probable that if the crop out of which the corn was threshed was infested by Hessian Fly, that the infestation will be imported, and will be spread abroad by distribution of cheap screenings.

But beyond what may happen as to introduction of this one special crop-pest, in addition to the weevils, beetles, &c., which it has long been known infest imported cargoes, as well as granaries on land, it appeared that in what may be called the “crop rubbish” thus imported there was broken straw, masses of caterpillar-workings, and bits of broken ears, with other impurities quite suitable for transmitting crop-insect infestation, besides other matters, such as ergot, weed-seeds; infested crop-seeds, as Maize, Beans, &c.; besides a large admixture of bits of dry dirt and stones, and also some amount of coal, iron, or large nails, and wire.

By the courtesy of the heads of some of our large mill-firms, I have been furnished from time to time with samples of the various kinds of the above waste products, many of which are, or certainly may be, vehicles for transmission of attack when spread over the country for feeding-stuffs, or bedding for pigs, &c., as now happens from the cheap rates at which they are purchasable.

But as, in drawing attention of agriculturists to the danger run in using these screenings, there might be blame attached to myself in venturing to bring forward a point which (if followed up) might interfere with due and proper profit to millers, I have made inquiry on the subject of various well-known firms, and it will be seen by the replies with which I am favoured that the dirt and dangerous rubbish sent over is *not* desired by them (as, amongst other reasons, it involves the use of expensive machinery which would not otherwise be requisite); also it is shown that the corn *could be transmitted* either clean or much cleaner than it now comes. I venture therefore to give some of the notes with which I have been favoured in reply to my inquiries on this important matter, by which it will be seen what countries the foulest imports are sent from; various causes for the presence of impurities; some amount of statement of percentage of these in adulterated or not cleaned Wheat imports, and price at which these waste products are sold; also of treatment requisite to clear the corn; and also measures of protective co-operation which are now taken to some extent, and which are open to much wider adoption, by importers at their own pleasure, to guard themselves against unlimited impurity of cargoes transmitted to them.

To these notes I have added descriptions of various kinds of waste products screened, or removed by various means from foul corn, of which I have been favoured with samples, and also figures and observations regarding some few of the insect-pests which either do or may easily come in these uncleaned cargoes, and which it would be well for agriculturists to be on their guard against, and report on their first appearance; and also a short account of a small moth (figured at p. 56), which appears to have been introduced from the South of Europe during the last few years, and of which the maggots are excessively troublesome by choking the working of apparatus in flour-mills.

The following communication, with which I was favoured on June 1st, is from Mr. Hibbard, of the firm of Messrs. J. Reynolds and Co., Albert Flour Mills, Gloucester, on introduction to him of my request for information by Mr. Marshall Sturge, of Gloucester. After mentioning that my letters *re* Russian grain, shipments, Wheat, and Barley, had been handed to him by Mr. M. Sturge, Mr. Hibbard wrote as follows in reply to my inquiries:—

1. *Is grain sent now in worse condition than formerly?* I do not think

so; there seems always to have been a selection of cargoes for the English market, containing an undue proportion of impurities, and it has generally been considered that we have more impurities in our Russian Wheats than was grown with them,* while Marseilles at the same time was getting choice quality and clean Wheat.

"2. *Could the sending of foul grain be stopped?* Certainly. The Bristol Channel merchants have stopped the excessive adulteration of Russian Barley by only buying Barley subject to analysis, and stipulating that there shall not be more than 8 per cent. of impurities. To enforce this they have become liable to each other in a heavy bond of £500 for each infraction. Since the agreement has been in force the Russian shippers have been able to ship to comply with above. No comment is necessary.

As regards Wheat, the lower qualities, we suspect, are made by mixing fair qualities of Wheat with Rye, and separations from other Wheats, such as Cockle, Oil-seed, &c.†

"Generally, with all Russian Wheats, there is a great amount of impurity. This impurity consists of pieces of dirt, Rye, Cockle, Oil-seed, Vetches, thin shrivelled grains of Wheat, and frequently stones, &c. If the Wheat was ever winnowed, the out-siftings and separations must have been carefully put back again. It is perfectly impossible to get a sample of Russian Wheat quite clean; there is always some hard dirt and Rye in it. Thus Russian can never be depended on as a basis for first-class flour. It is a great pity that it is so, because, if the English miller could get Russian Wheat clean, America would not injure him so much by her shipments of flour.

"Average weight and value of screenings from Russian Wheat.

Reckoning a quarter of Wheat as 500 lbs., and worth 35s.

					per qr.
					£ s. d.
1%	thin shrivelled Wheat at £3 10s. per ton	..	..	..	0 0 1½
1%	cockle and other seeds .. .. .	..	..	..	0 0 1
5%	Rye and small Wheat at £4 per ton	..	..	..	0 0 10½
1%	large and small impurities and dust at £2 per ton	..	..	..	0 0 1
<hr/>					
8					0 1 2½
	8% of Wheat as above value	..	..	..	0 2 9½
<hr/>					
	Nett loss	..	..	..	0 1 7

"The lower qualities of Odessa and Azov Wheat would contain not less than 40 per cent. of impurities, mainly Rye."

For the following communication I am indebted to the courtesy of Mr. H. C. Woodward, of the firm of Messrs. H. C. Woodward and Co., Corn Brokers, Liverpool:—

"I have been requested by Mr. Capper to send you a line in reply to your letter to him of the 11th of May, in reference to the foul state

* See observations, p. 64.

† Id.

in which large cargoes of foreign Wheat and other grain are imported, leading to the risk of propagation of obnoxious insect-life, such as Hessian Fly, &c.

" I think there is no doubt that both merchants and millers would very much prefer that such cargoes should arrive perfectly clean, and free from dirt, straw, seeds, &c. ; and Wheat that does so arrive always commands a better price in the market. But you are probably unaware of the very primitive modes of harvesting Wheat in some of the countries whence large supplies come. The poverty of the growers will not allow them to use expensive cleaning machinery, while again the keen competition among shippers tends frequently to the receiving grain direct from the grower in bags, and shipping it right on by vessel, instead of, as formerly, taking their purchases into warehouse, and cleaning and mixing the various small lots into one uniform bulk. This especially applies to California, where much of the Wheat, if not all, is threshed off the field and bagged at the same operation, shipped in same bags of various qualities, often full of straw, &c., and then piled on the quays and bulked in Liverpool on arrival.

" Here the straw is not liked, but put up with, as it does not weigh much, and the Wheat, being very dry, has a tendency to absorb moisture, and thus gains in weight as much as it loses in straw, or probably more. What is more objectionable to a miller is the large quantity of earth or soil mixed with Indian Wheat. This partly arises from its being stored in pits in the earth, and then, when opened, the earth gets mixed in. Sometimes this is purposely done to gain weight. Again, in the River Plate, some of the Wheat is actually trodden out by horses instead of properly threshed ; hence you have impurities, and soil, stones, &c., often mixed, and the samples are valued according to percentage of these impurities. In the case you mention of a sample containing bits of coal, iron, nails, &c., it is more than likely that this contained part of the sweepings out of the hold of the ship or of the quay. These vessels often take coal for outward cargo and bring home grain, and, if not swept perfectly clean, some of the coal, &c., get mixed. Other samples often contain bits of wire, &c., arising from a wire-tie used for binding sheaves ; so millers mostly have large magnets set with their screens so as to catch iron-wire, nails, &c., and prevent damage to stones or rollers used in milling.

" Strong representations are made (especially to Bombay Chamber of Commerce) with a view of checking large dirt admixtures, with only partial effect so far ; but you see, with such a variety of causes, it is not so simple a matter as it might appear to any one not in business. A discrimination in price has some effect, and is fully practised."

In the following notes, with which I was favoured by Mr. Thomas

Rigby, of Sutton Weaver, near Warrington, Secretary of the Royal Liverpool, Manchester, and North Lancashire Agricultural Society, he mentioned from operations at his own mills :—

“ We are not using any Russian Wheat just now. It is a very poor Wheat, and very dirty and ill-cleaned at home, as also is the Indian Wheat, and the River Plate Wheat; the latter is better Wheat than Russian, but comes in quite as dirty, and as full of straws in short pieces, and of chaff from the grains. We find the Indian Wheat has most heavy rubbish in it, consisting of small, hard lumps of dirt and clay.

“ We have to wash and to soak sometimes this sort of Wheat (to soften the lumps and so wash away the earth) and the other hard kinds. Little flies often come out of the grains when it is being damped, and when it is passed through strong currents of air that we put it through to draw out the chaff and straw.

“ Your correspondent says rightly, ‘ millers would rather have clean cargoes,’ for it requires both very expensive and complicated working machines to clean Wheat fit for use, and is great loss. We have just been putting in some new machinery, and are now taking out six separate sorts of rubbish that had very little money value.”

On August 28th, Mr. Rigby further favoured me with the following information regarding Barley :—

“ In answer to your query about Barley importation : We do get large quantities into Liverpool from Sweden, Norway, Germany, Russia, Egypt, Australia, and the River Plate. The Egyptian is the poorest; I enclose you a small sample. It often comes full of weevils and mites, and is sometimes not so well cleaned as this sample, being more ‘ taily,’ or having the tails broken off it in abundance, and sometimes particles of straw.

“ The *débris* taken out of Indian Wheat is the chief source of danger of carrying insect-life or spreading it . . . ; it is of little value, and is used for feeding poultry, and in some cases pigs pick up what grain there is in it. The manure of said pigs is a fruitful source of weeds afterwards.”*

From Hull I was favoured both by information and by samples of different kinds of waste products removed from foul Wheat (described in detail further on), and have to express my thanks both to Mr. Ellis and Mr. Kirby for the assistance kindly given me.

At my request Mr. Edm. Riley, of the Weir, Hessle, near Hull (who assisted me for many months in investigations relatively to importation of Hessian Fly in imported straw), was kindly favoured by

* The above remark as to spread of infestation is well worth observation regarding all animals, including poultry, which feed on the infested screenings.

permission to go over two of the large corn-mills at Hull, and also to forward to me samples of the different kinds of screenings; and I was also favoured by the following information in a letter from Mr. Kelsey, of the firm of Castle, Kelsey and Son, Hull:—

“In answer to your inquiries, all foreign grain imported into this country now comes in a much cleaner state than formerly. Egyptian grain still contains a large admixture of soil, stones, and dust, but their finest quality of Wheat now comes much clearer, and makes correspondingly higher prices; and there is no reason that this country should still continue to ship their ordinary or fair average quality of Wheat and Beans in such a dirty state, as they could dress the same before shipment, and receive better prices on our markets, if the dust and dirt were kept in Egypt.

“The same remarks apply to Indian Wheats. Both these exporting countries give us sufficient proof that they can ship their grain in a good, clean state, if they like to be at the expense of using the machines they possess for the purpose. Shipments from these countries realise comparatively low prices, owing to their dirty state, with which importers and millers are well acquainted, and protect themselves to a certain extent by contracts containing full description of quality, &c., and an arbitration clause in any dispute between sellers and buyers should arise respecting the same.

“Indian shipments are now considerably better cleaned, and of better quality, than used to be the case some years since; while Egypt seems to prefer shipping as much soil and dirt with their grain as they think it probable importers in this country will submit to, although they frequently contract for the bulk not to contain more than 7 per cent. dirt, and if more is found they have to pay an allowance in accordance with the analysis and arbitration award.

“Considerable loss is often experienced by importers in this country when grain is shipped in such a dirty state; owing to the length of passage the grain becomes very warm (especially in summer time), and weevils often exist to a very serious extent, doing great injury, and causing great waste and heavy loss to importers.

“Millers in this country, with their greatly improved machinery, easily wash and clean such descriptions of grain, and are, by their practical knowledge, well able to protect their own interest in what they buy from importers, the latter running the great risk of the evil effects of weevils, &c., while in passage. Millers would much prefer having to deal with good, sound, sweet, clean grain, and pay extra prices for it.

“Shippers do not take into sufficient consideration that they pay freight and charges for such large percentage of dirt that they ship, or that they would get much better prices for their corn if they kept at home all the soil and extraneous matter alluded to.

"Russia ships much cleaner than formerly, but South Russia still continues to send many cargoes of Barley especially with large percentage of admixture of dust, dirt, and seeds.

"At all principal ports in the United Kingdom corn-trade associations are established, or are being established, for protecting the interests of importers and millers, and are doing more than anybody else can do to teach foreign shippers that it is to their own interest to cease their old custom of shipments in such unclean state as your correspondent alludes to."

I was further favoured with a note from Mr. Riley, after going over two of the large corn-mills in Hull, that in both cases any assistance in investigation would be gladly given, as the dirty state in which the Wheat comes in was much complained of, it being thus so much more liable to breed weevils, "especially the late shipments, which are sometimes nearly alive with them"; and also I was supplied with samples of the different kinds of screenings, of which Mr. Riley wrote as follows:—

"I have sent you several samples of rubbish taken out of the Wheat; it is from Californian, Indian, and Russian Wheats; they are all mixed in certain proportions, and taken to the top of the mill and put through several screens, brushes, and exhausts. The bags are numbered. No. 1 is principally short straw, and sold for pig bedding, &c.; No. 2 (screenings) is sold for hen-corn; No. 3 is small, broken corn and seeds (for which there is a market, as also for No. 4, but the uses of these were not named); No. 5 is not of much use, as it is generally stones and lumps, and larger things than corns of Wheat, &c. I also send samples of Indian Wheat, which, if not now, will soon be full of weevils, as that class of corn gets warm on the passage."

Of the above samples, No. 1 (now before me) proved to be composed mainly of broken bits of straw running up to about 2½ inches long, bits of the stem of the ear from which the Wheat had been detached, and likewise morsels of the Wheat-ear with the grain still adhering, and grain with and without the chaff. There was a slight admixture of small sticks, bits of wood, and a little Maize, Pea, and weed-seeds.

By means of pieces of straw such as these it is perfectly possible that corn-stem attacks may be transmitted in maggot or chrysalis-state, either within the tube of the straw or outside it, secured from injury by the sheathing-leaf.

No. 2, hen-corn, was chiefly of small or shrunken Wheat, with broken grain and chaff, together with some amount of weed-seed, &c.

No. 3 was (as mentioned above) composed of broken corn, with small grains, and much small roundish black or dark brown weed-seed intermixed.

No 4, mainly of dust, with some admixture of bits of straw, chaff light grain, &c.

No. 5, composed of bodies larger than the corn-grains, is sometimes known under the name of "rubble," and consists of dirt and rubbish of all kinds that chance may have brought together. In the mass before me are bits of straw, and of ear of Wheat, grains still in the chaff, seeds like misshapen peas, a large proportion of stones and hard bits of dirt, also some amount of such matters as sticks, string, potsherds, leaves, &c.

From the Isleworth Mills (Messrs. Samuel Kidd and Co., Limited, Isleworth, near London), I have been permitted occasionally to have samples of the screenings from imported corn, and information on the subject, both whilst resident in the neighbourhood and since I removed to St. Albans, and have recently been favoured by the following letter from Mr. Perry, director of the mills:—

"We are in receipt of your favour, and so far as possible we reply to your queries.

"The practice of sending foreign Wheat mixed with rubbish has certainly increased of late years, and we find it particularly so in that coming from Australia, East Indies, and Russia. It would be a great advantage to millers to have the Wheat shipped clean, or free from admixture of foreign substances other than Wheat.

"We could not give a reliable estimate of the quantity removed in cleaning per ton. It varies considerably, according to the country from whence it came, and the particular shipments received. The value of the rubbish removed is *nil*. The value of screenings, which includes small defective corn unfit for flour, cockle, seed, &c., is about £3 10s. to £4 per ton.

"It is not in the power of the importers, unless by combination together, to insist on getting Wheat shipped free of impurities, and it is a well-known practice on the part of foreign shippers to add in mixture of Rye with Russian Wheat, and with Indian Wheat to mix seeds and dirt. We should be desirous to procure our Wheat clean, as it would save us from loss and expense in cleaning; we have in this process to use expensive and powerful machinery."

One set of samples of refuse (removed from Wheat imported from various countries and mixed at the mills), with which I was obliged in 1886, were of four kinds. One known as "rubble," of much the same nature as No. 5, above mentioned, consisted of bodies larger than the Wheat-grains, as lumps of earth, Maize, Beans, &c.; first and second screenings composed of broken corn, bits of straw, chaff, &c., and other bodies smaller or of less diameter than the Wheat-grains; and (fourthly), black dust, which consisted almost wholly of mere dust driven by a blast from the grain in process of cleaning, and which, until the Thames regulations prevented, was formerly got rid of by being floated away down the river.

More recently, as occasion in my insect-work required, I have been obliged with more samples of refuse, one especially showing (like No. 1, from Hull, above mentioned) the quantity of bits of broken straw which are removed from imported grain, and another of "rubble" from mixed corn from Germany and Russia.*

* In regard to possible method of adulteration of S. Russian Wheat (although it is probable that all this is much better known than by myself); nevertheless, it may be permissible to add that in the course of last year, on showing samples of impure Wheat to an English correspondent, formerly resident, and engaged in practical farming in South-eastern Russia, he offered the following observations, remarking at the same time that he wished specially to mention that it was now some years since he had been resident in Russia. I have therefore inserted "was" for "is,"—that is, past for present tense,—in description of operations:—

"The very dirty state in which the Russian grain reaches England is, in my opinion, due to two causes. Firstly, to the very primitive method adopted by the peasantry and others for threshing the grain; secondly, dishonest practices.

"When grain had to be threshed out, the usual plan was to clear, by sweeping, a space of hardened ground, either out in the fields, or more frequently in the village street. The crop was then laid down, and horses driven round and round, which by their trappings effectively separate the grain out of the ear. The straw was then removed, and the grain swept up into a heap; chaff, bits of straw, pieces of earth, and horse-droppings were thus naturally all swept into the heap.

"To separate the grosser particles of foreign matter this mixture was put through a sieve with very big meshes, and then what had passed through the sieve was tossed into the air by means of wooden shovels; the grain and other heavy particles fell into one heap, while the chaff was carried by the wind to a slight distance. But as the whole operation was of the crudest nature, you can well conceive that, after all is said and done, the grain was in a very dirty state when it came to be sold."

My correspondent further stated that if the supply came short, it was then a common practice adopted by the merchants' agents to mix rubbish with good, clean samples, in order to increase the bulk; and that he was personally aware of the siftings being sold to these men for the purpose of mixture.

For obvious reasons I do not give my correspondent's name. If any point of interest occurred on which further information was wished, I would forward application; I have no doubt he would enter on all details.

The following published observation of what went on some years ago is of interest, as, judging by what is received at the present day, similar arrangements may be continued:—

"Grain, and more especially Linseed, comes to England full of weed-seeds. Here is an explanation. At Timashevo last year some well-dressed Linseed was sold in town at 1·40 roubles per pood; the weed-seeds extracted by the cleaning and dressing, consisting of all the worst annuals that grow here, were sold at 75 kopecks per pood, the merchants having applied specially for them in order to remix with the better-dressed Linseed and Wheat."

'A Sketch of the Agriculture and Peasantry of Eastern Russia,' by Henry Ling Roth, 1878. Baillière & Co., King William Street, Strand. (Paris and Madrid).

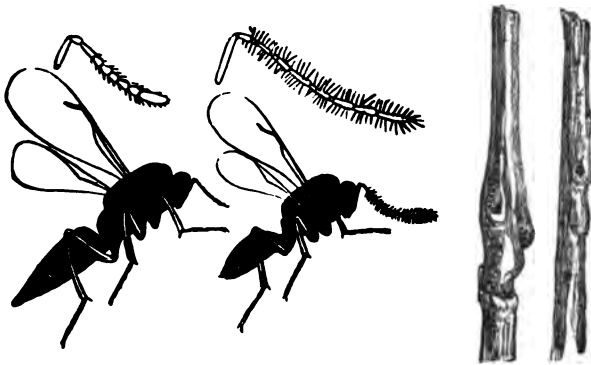
(The 1·40 roubles per pood mentioned above equals about one penny and a sixth per English pound, and the 75 kopecks rather more than one halfpenny. —H. L. R.)

From the foregoing observations it appears that a great deal of impurity is shipped with the Wheat ; also that these refuse accompaniments are quite unnecessary to the extent to which they come ; also that their presence to a great extent may be prevented by joint action of importers, excepting, of course, where a stated amount of adulteration is permitted ; and further, that these refuse-matters are not desired by millers, as their presence entails necessity for expensive machinery which would not otherwise be wanted.

Therefore, as it appears that the absence of refuse in the corn-cargoes would not injuriously affect the importers or millers, but, on the contrary, that clean cargoes would be preferred, it is allowable to draw attention, agriculturally, to the great risks that are run by purchase of what is (or in all probability may be) infested refuse, and thus in various ways allowing noxious insects, eelworms, fungi, or weeds to gain a footing.

The great hope that we may not suffer in field produce from this cause lies in the notable fact that imported field-pests (at least as far as America is concerned) have not taken hold here to any degree ; compared, that is, to what our pests do in America ; and therefore we may hope to continue to be tolerably free. Still, Hessian Fly, though probably derived from Europe, has made good a footing, and there are two or three other attacks which, under present circumstances, it would be well to be on the watch for.

One is the "Joint-worm" of North America, the *Isosoma hordei*,



ISOSOMA HORDEI, Harris.

Female and antenna ; male and antenna (all much magnified). Nat. length of fly about one-tenth of an inch or rather more. Galls on straw caused by Joint-worm.

Harris (figured above), together with some bits of straw showing the galls by which this attack may be recognised. This joint-worm lays its eggs in summer in the stalk of the growing plant of Wheat, Barley,

or Rye. The footless yellow maggot, which soon hatches, feeds in the kind of gall-growth which it causes by its presence (see figure), and remains in the ripened straw, where it turns to the pupa-state, from which the fly comes out during June of the following year. It appears, therefore, that the attack may be easily carried on to our farms (if in the straw) by the short morsels sold for bedding.

The "Wheat-stem maggot" of the small two-winged fly, the *Meromyza Americana*, is another kind of serious corn-stem attack, for which I am on the watch, because in 1888 I had a specimen sent me out of Kent, resembling this very destructive maggot both in size, shape, and its peculiar green colour. In descriptions of this attack the ear is stated to be destitute of grain, and the stem shrunk for about three or four inches above the joint. The maggots are described as about a quarter of an inch long, tapering to the head, blunt at the other end, and of a watery green colour, one in each stem, feeding a little above the joint, so as to cause the stem to be utterly shrivelled and worthless for conveying the sap, and the chrysalis to be found at the same spot on removing the sheathing-leaf.

The minute two-winged fly is only about a quarter of an inch across in spread of the wings, with a black spot on the top of the head; the body between the wings, and likewise the abdomen, marked with three black stripes running lengthwise, and the eyes are green.

There are other field and corn-attacks which might apparently be transmitted in refuse, but I mention the above as more especially likely, as far as I can judge, to be found present, and, if observed, I would at once give my best attention to any communication on the subject.

The attack of the caterpillars of a Flour Moth can perhaps scarcely be included amongst those of crop insects; but as in this case the very injurious moth (scientifically the *Ephestia Kuhnella* of Zeller) has but recently established itself in this country, and its first observation on the Continent of Europe took place no further ago than 1877, it may be of service to give a few notes of some of the successive trustworthy reports of its appearance, as well as a figure from life, and some observations of its history and habits.

The first European observation of this Flour Moth was made in the summer of 1877, when, as recorded by Prof. P. C. Zeller, of Grunhof,* specimens were placed in his hands by Dr. Kuhn (Director of the Agricultural Institute of the University of Halle, Germany) of moths which had been very troublesome in the bolting-cloths during the grinding of a quantity of American flour, with the request that Prof. Zeller would ascertain their names. These moths proved to be of a previously undescribed species of *Ephestia*, which was named (after its

* Ent. Zeit. Stettin, 1879.

observer, Dr. Kuhn) *Kuhniella*; and in Prof. Zeller's excellent paper referred to, full description is given of the moth, and the differences between this and other species of *Ephestia*, also descriptions of the caterpillar, and much useful matter regarding habits, &c.

The first recorded observation of the appearance of the attack in this country was, as far as I am aware, made by Mr. W. Thompson, of Stoney Stratford, Bucks, who reported in the number of the 'Entomologist' for May, 1887,* that the moths bred from "Rice cones," regarding which he had previously written, had been identified by Mr. Barrett as a species new in this country—namely the *Ephestia Kuhniella*, which had been (as above noted) recorded some years before in Germany by Prof. Zeller.

In June of the same year larvæ were exhibited (at the South London Entomological Society) from a cargo of flour which was reported to be partly destroyed by the above-named kind of caterpillars, from which, during July, moths hatched, which were identified as of the above species, *E. Kuhniella*.

Later on (that is, on Nov. 2nd, at a meeting of the Entomological Society of London), Mr. Sidney J. Klein read some notes of his observations on the habits of this *E. Kuhniella*, in which he mentioned that in the preceding May he had "discovered a colony of this scourge of the Mediterranean ports in some large warehouses in the east end of London. There were over a thousand tons of flour stored in close proximity;" and "the attack spread with great rapidity, until one entire warehouse was literally smothered with larvæ, and several hundred pounds' worth of damage was done." Some interesting observations were given as to attempted remedial measures, also regarding habits of the caterpillar, and benefit expected from the presence of a parasitic ichneumon fly.†

Some observations on this attack, and some which appeared to refer to it, were sent to me, but it was not until the autumn of last year (1888) that a complaint was made to me of it as a very serious flour-mill pest, with specimens of infested flour accompanying, from which I was able to study the attack myself, and also to rear the moth.

On Sept. 15th the following communication was sent me by the owner of steam mills in the North of England‡:—"I have got quite a plague of moths in the mill, some of which, and worms, I send you; they get into the spouts and machinery, and do no end of mischief both by destroying the silks and stopping the flow of flour, &c., in the

* The 'Entomologist,' No. 288, p. 139. Messrs. West, Newman & Co., Hatton Garden, E.C.

† 'Trans. of Entomological Society,' Part IV., Dec. 1887, p. lii.

‡ For obvious reasons, as well as by special request of my correspondent, I do not give name or locality.

spouts by spinning thin web and hanging there. The mill is in constant work, and I should have thought this would have prevented them from lodging, but it does not seem to affect them at all. You will perceive the difficulty there is in putting anything in the spouts that would affect the flour."

The flour sent showed the great difficulty of the case, for it gradually became spun together, and also to the sides of the box in which it was placed, by the caterpillars' webs, so tenaciously that it could be lifted in lumps, and only a little flour let fall; whilst some still clung to the sides of the box, almost as if in sticky lumps. From the specimens sent I reared a few moths about the end of November, which proved on comparison (for which I am indebted to Mr. O. E. Janson) with type specimens, which had been compared with those of Prof. Zeller, to be true *Ephestia Kuhnella*, Zell. One of these specimens is figured at p. 56, magnified, with natural size given accompanying. The colour of the fore wings may be generally described as of rather pale grey, with darker transverse markings, and the hind wings are peculiar for their whitish semi-transparency, with a darker line from the point along a part of the fore edge.

On examining the infested flour early in January the mass was so completely spun together that, after pulling some lumps of it away, I found that the rest hung down in ragged lumps or clots so felted together by the caterpillars' web that but little flour remained in loose state. From a small mass of these clots, little less than two inches and a quarter, by two inches across, and half an inch deep, I could only by repeated shakings get about a teaspoonful of flour. The spun-up masses were occupied by live caterpillars, some chrysalids living and dead, and remains of dead moths.

The caterpillars varied in size from two-eighths up to five eighths of an inch in length, and correspondingly in colour, the younger ones being of flesh or pale red colour, and the largest almost white; the shape cylindrical, somewhat slender, with 16 feet, that is, three pairs of claw-feet, four pairs of sucker-feet, and a very well-developed pair besides beneath the tail, by the help of which, although the largest of the larvæ were sluggish, the younger travelled nimbly, and could move backwards or forwards at pleasure, or were able to attach themselves at once to a foreign substance, as the finger or hand. The head yellowish brown, darker in front, and with dark brown jaws; a transverse patch on the segment next the head, this rather pale yellowish brown, with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch. Along the back, excepting towards the head and tail, were four small dark dots on each segment, above, two on each side the centre. On the segments near the head the spots

were arranged more transversely, and at the tail, immediately above the sucker-feet, was a brownish, oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat in different specimens; the largest was in the middle, with a smaller one on each side, occasionally one below, which would make five altogether; but sometimes the lowest pair was absent, sometimes the middle large spot was not entire; conjecturally the marking differed with the age of the caterpillar. On the preceding, that is, the eleventh segment, there were two clearly-defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment.

The caterpillar was slightly sprinkled with pale hairs or fine bristles, and had such a capacity for catching and retaining a covering of flour that I was obliged perpetually to remove it with the moistened tip of a finger to obtain a clear view of the markings.

The chrysalis, which was lying in a silken cocoon of spun-up flour, showed the chief points of the form of the coming insect plainly—the colour bees-wax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged, slightly-curved tail, which ended bluntly or cylindrically; the eyes of a darker shade of red. There were remains of dead, partly-developed moths or chrysalids in the box, but I could not make sure whether, as thought not unlikely by Prof. Zeller, these had been destroyed by their caterpillar brethren—the size and power of their jaws make the cannibal habit appear very probable. I had not opportunity of observing how long the chrysalis state lasts before the moth appears from the chrysalis condition, but this time is given by Prof. Zeller as three weeks.

The attack may be considered as going on constantly where temperature is suitable, for we have notes of appearance of the moths in May, June, July, November, and December; and intermediate observations of larval or pupal presence point to this, which, when once established, is indeed a mill or flour *scourge*, as being a year-round pest.

With regard to measures of prevention or remedy. In the application made to myself, the difficulty was (as mentioned at p. 67) the extent to which the caterpillar working clogged the apparatus, and I suggested the possibility of destroying the caterpillars by turning on hot steam from the engine, a plan which I knew had been perfectly successful in clearing a cheese-factory of maggots which had spread into chinks and crannies to a most inconvenient extent; and on Nov. 8th the following report was sent me by my correspondent as to the (so far) satisfactory progress of the work of getting rid of the moths:—

“I am beginning to hope I have almost seen the last of them; at

any rate, they are nothing like so numerous and troublesome. Acting on your suggestion, I stopped the mills for a week, and had all the machines cleaned through, and then went over them and the walls with steam; and now we are whitewashing the walls and underneath all floors with fresh-slaked lime and paraffin."

On Nov. 20th my correspondent further reported that he had not written sooner, wishing to record a positive clearance of the pest:—"Unfortunately I cannot say that, just yet, though I have reason to hope that our continual exertions will prove successful; there are comparatively but few moths about, and I rather think the paraffin and soft soap is not very agreeable to them. . . . The way I applied the steam was by carrying about forty yards of half-inch piping into the mill from the boilers, and attaching an india-rubber bore to it for the men to work about on the walls, floors, spouts, and machines, blowing the steam into all the crevices and holes.

"I think I told you I stopped the mill for a week whilst this was being done; it has rusted all the shafting, &c., but this is quite a secondary matter: it can soon be cleaned again. After blowing the steam, which took two or three days, I set the men to work to wash the walls (and everywhere that they could without fear of affecting the flour) with paraffin; inside the machines I had washed with a strong solution of boiling water and soda. I find that strong soda and water is effectual in destroying the maggots when it can be got on them. I still continue washing and *syringing* all likely places for them to settle with paraffin, and keep a lad or two going about brushing up and killing all the moths they can see."

The preceding observations given *verbatim* point out, I think, more strongly than any description the serious nature of this attack, which, even by such stringent, well-conducted measures, *cannot be entirely got under*.

The great point in the habits of this pest which we need to meet is its custom of infesting every nook that it can reach, and also its power of forcing itself into or out of the most apparently secure spots. This is noted by various observers.

In Mr. Klein's observations (previously quoted) he mentions that his specimens, which had been placed "under a large glass shade on a polished wooden surface, with no perceptible outlet," conveyed themselves out in some way so that the corners and ceiling of his room were within a week studded with their cocoons," and specimens were every day discovered about the house from top to bottom.

In my own observation I placed one caterpillar about a third grown under a small cardboard case on a woollen tablecloth, so that there were no spaces for exit, and on the top I placed a 1 lb. weight, but before long the creature was on the outside.

In my own experiments I noticed the caterpillar could on *dry* annoyance let itself down by a thread, but on moist application I did not see that it attempted it, and this might possibly point to syringing down being serviceable (as noticed in foregoing observations).

At present one *most important* point on which we need information is—where from, and in what manner, do these pests travel to us; and next, how are they transmitted now that they are with us?

In the very first record of their appearance they were found in grinding American Wheat; this was in 1877, and Mr. Klein (see paper referred to in 1887) mentions them as “a scourge of the Mediterranean ports.” On enquiry I find the *Ephestia Kuhnella* not included in Grote’s list of N. American Lepidoptera for 1882, so that investigations point rather to Europe or the East as the exporting centres.

Regarding this, I enquired of my correspondent whether there was reason to suppose they had come in Russian Wheat. He replied:—“Though I had been a large user of that for the last twelve months, I scarcely think they have come in it, or other millers would have found them in their mills. Moreover, they do not seem to trouble us at all in the warehouse where all the grain is stored, but only in the flour, and especially in any light fluffy or branny stuff. My impression is that they have come to me from some baker in returned empty sacks. Is it possible that they could have spread in this way from the flour in London, as recorded in the pamphlet you sent me?”

Nothing is more likely than that such should be the case. Mr. Sidney Klein, in his paper read before the Entomological Society (referred to at p. 67), mentioned that the eggs which seemed to be laid by the moths “generally upon the top of the sack hatched within a few days of being laid, and the larvæ (caterpillars) at once burrowing through the sacking, commenced spinning long galleries in the flour, seldom, however, going more than three inches from the exterior.”—S. T. K.

Relatively to this matter, perhaps safety could be secured as to sending on the pest from infested centres by baking the sacks; a warmth far below what would do any harm to the sacking would probably destroy all vitality of the pest from egg up to moth state, and it would be very useful to know whether, excepting the single observation of the infestation being found in “Rice-cones,” the caterpillars affected other flour than that of wheat. Prof. Zeller mentions they are considered by millers to reject Rye-meal; and at a glance this suggests that if Oat or Barley-meal were similarly obnoxious to caterpillars, something might be done by temporary change of corn ground to clear out the pest. But on inquiry the different nature of machinery introduced largely for flour-milling in

England during the last ten years, instead of the old system of grinding by millstones, appears to preclude this plan of remedy.

Any information which would throw light on reasons for the presence of the moth, or means for prevention of its attacks, would be very desirable.

"Tulip-root" and Segging; Eelworms. *Tylenchus devastatrix*, Kuhn.; and *Cephalobus rigidus*, Schneider.



"Tulip-rooted" Oat-plant.

The diseased growth in Oat-plants, known from its peculiar bulb-like form as "Tulip-root," is caused (as has now been shown by the repeated observations of several years) by the presence of multitudes of minute Eelworms within the plant, these being much too small to be seen by the naked eye, though, where there is bad attack, their presence may often be guessed by the kind of whitish or pale brown powdery appearance of the inside of the infested plant.

The kind which causes the "Tulip-root" disease is scientifically the *Tylenchus devastatrix* of Kuhn, formerly known as the *T. dipsaci*, from its being then considered especially to infest Teazles; but latterly (since its history has been taken up), from the great number of plants it has been found to attack, and the great mischief it has the power of causing, amounting sometimes to devastation of whole districts on the Continent, the special name has been changed to *devastatrix*.

As the history and treatment has been given in my previous Reports, it does not seem desirable to repeat them here; but it may just be mentioned that the two British crops which it especially affects are Oats and Clover, producing in the latter the form of "sickness" often known by swollen, distorted shoots. Barley appears not to be liable to infestation, and Wheat but little; Rye worse than any other plant in continental growth, but not, as far as reported, in Britain.

Two practicable measures of prevention of recurrence of the attack on infested land are avoiding crops that can be affected in the rotation, and to give deep ploughing; the Eelworms often leave the Oat-plants as the plants die, or dry from maturing, and lie in the upper surface of the soil; and if they are well turned down, especially if circumstances allow of a dressing of gas-lime in caustic state being put on, much of the infestation will be got rid of.*

Special applications which have been found to do good, as manure in preparation of the land, or as dressings to bring an infested crop over attack, are sulphate of potash alone, or as a mixture with sulphate of ammonia and phosphates.

In the following observations notes are given of these applications having again been found serviceable in the past season, and also a few notes of presence of the infestation in various localities sometimes to a troublesome extent.

On March 29th I was favoured, by Mr. Richard Brown, of Hillhouse, Kirknewton, Midlothian, N.B., with the following note of the previous season's observations regarding use of sulphate of potash:—

"I regret that I neglected to inform you last year that the field of Oats which, in the beginning of June, showed every sign of being badly affected with 'Tulip-root,' and from which the specimens sent you were taken, received shortly thereafter a top-dressing of about 1 cwt. per acre of sulphate of potash, with the result that the disease entirely disappeared, and at harvest an excellent and thickly-planted crop was out. It is right to state, however, that the season seemed to have been unfavourable for the spread of 'Tulip-root,' as comparatively little was seen in the district."

The following observations, sent me on June 15th by Mr. John Elder, of The Holmes, Uphall, Linlithgow, N.B., are in continuation of observations of careful experiments made by him in the preceding year, of which he kindly gave me full details, and of which I published the main points in my Eleventh (1887) Report.

The following note shows the benefit of the dressing given, excepting on a badly-drained part of the field, and on a sandy knoll, and on this sandy knoll the portion to which stimulating manure was applied before ploughing was promising well:—

"The following is my experience regarding 'Tulip-rooted' Oats as far as this season has gone yet. They are sown on the fields from which my specimens of sick Clover-plants were taken last year. The manure applied consisted of phosphates, ammonia, and potash when sown, 3 cwt. per acre. The whole has a very luxuriant growth, with the exception of the sandy knoll, from which last year's No. 1 specimen

* For method of safe use of gas-lime, see pp. 80, 81, and Dr. Aug. Voelcker's leaflet on gas-lime there referred to.

was taken, and which shows a good deal of 'Tulip-root' this year too. The other portion of the same knoll, from which No. 2 was taken, had an application of town-manure before ploughing, and, though a few plants show the symptoms of 'Tulip-root,' the general luxuriance is so good that a full crop is promised. The only other portion showing damage is where No. 8 was taken from (the portion not very well drained). It is not so bad as No. 1, and is now mending every day."

The following detailed note of experiment on special Oat-plants, also sent me by Mr. Elder on June 15th, shows that, at that date, the unmanured land was giving the most unhealthy crop; that with steamed bone-flour came next; the plot treated with sulphate of ammonia had a number of unhealthy plants, but was better than what was unmanured; and of the two others, both were doing very well on the whole, but that treated with the mixture of sulphates and phosphates was better than that treated with sulphate of potash alone.

"No. 1. *Steamed Bone-flour*, 8 cwt. per acre, got very yellow for a while, but has now taken on a growth; a number of unhealthy plants on this plot.

"No. 2. *Sulphate of Potash*, 55 per cent., 8 cwt. per acre, was always fresh and green, and not an unhealthy plant on the whole plot; it is now, however, losing growth a little.

"No. 3. *No manure*, has always been the worst, having a great number of unhealthy plants, and a sickly yellow appearance. It is now mending a bit.

"No. 4. *Sulphate of Ammonia*, 1½ cwt. per acre, has also a number of unhealthy plants, though not so bad as No. 3. It has now taken on a luxuriant growth.

"No. 5. Mixture applied to general crop without top-dressing after" (the mixture consisted of about 2 parts of sulphate of potash, 55 per cent.; 8 parts of sulphate of ammonia, 25 per cent.; and 4 parts of phosphates, 48 per cent.) "has been similar to No. 2 all spring, perhaps not quite so dark a green. Plants healthy, with few exceptions. Gives promise of being the largest crop of any of the plots."

On July 14th Mr. Elder, according to promise, wrote me a further report, and mentioned—" 'Tulip-root' appears to be more widespread this year than ever, a very great deal of fine land between this and Edinburgh being infested, probably causing a loss of hundreds of acres of Oat-crops.

With regard to his own farm, Mr. Elder mentioned that it was not free from this attack, but that he appeared to have lessened it very considerably on one field which suffered very badly two years ago, which now had a very fair crop; and also that he had a fair crop on

the field mentioned (p. 78), excepting on a low-lying part round the knoll, which was bad with "Tulip-root,"—to which part a less quantity of manure was given.

Mr. Elder further added :—

"Regarding the prevention of this pest, I would suggest the following precautions, as the result of my experiments and observations this and past seasons :—

"1st. The land to be maintained, in as high a state of fertility as possible, with farmyard or town manure.

"2nd. Alternate with Barley or Wheat when practicable.

"3rd. Sow along with the Oats a manure containing phosphates, ammonia, and potash (the two latter in considerable quantity).

"*Note.*—The plant appears to require more potash in its early stages than the majority of soils can readily supply it with, where the land is constantly under tillage : from one to two cwts. per acre of sulphate of potash, applied when sowing the Oats, will be found to keep the plant green and healthy, when without the potash it would become yellow after the supply of food from the grain was exhausted. This is the stage of growth when the *Anguillulidæ* make their attack, and, if the plant is carried on through this stage in a healthy growth, comparatively little danger may be apprehended afterwards. The ammonia would now step in, and carry on the plant during the remainder of its growth, the phosphates improving the grain.

"The above is not only theory, but it is the actual results of my experimental plots this season, as far as it has gone.

"4th. I observe this year that, wherever the broad-wheeled carts have crossed the Oat-fields, in carting out grain or manure or carting off stones, the plants in the track are extra strong and healthy, showing that perhaps my soil is too loose for Oats, and that the crop would be much healthier if rolled with a heavy stone roller, or some other contrivance, to consolidate the land.

"5th. Variety of Oats appears to have a marked effect. A field of 'Sandy' Oat is a fine level crop, Two bushels of . . . * Oat sown alongside, to finish the field, getting the same manure, &c., is very bad with 'Tulip-root.'

"Hamilton Oat appears to be more affected than Sandy and Victoria, or Polish Oat worse than either."

Specimens of Eelworm attack were also sent me from various English localities.

On June 11th Sir Francis Geary, Bart., of Oxon Hoath, Tunbridge, forwarded Oat-plants affected by "Tulip-root."

The following note, sent me by Mr. James Rawlence, of Bulbridge, Wilton, Salisbury, on July 12th, with specimens of bad attack of

* For obvious reasons I omit name of Oat.

"Tulip-root" accompanying, well confirms the observations of Barley not being liable to this kind of infestation :—

"There is a large area of the Oat-crops on our Wiltshire hills which have failed in different parts of the fields so cropped. I have a field sown with a mixture of Oats and Barley, which we call 'Dredge.' I noticed that the Barley was good, and the Oats almost a failure. I told my bailiff to ascertain the cause; yesterday he brought me what I herewith send you."

Besides the above, specimens of Eelworm-infested Oats were sent me from two localities, with much more of the reedy or sedgy form, to which the word "segging" or sedging is applied, than the peculiar "Tulip-root" swelling.

Specimens of Black Oats were sent me from Sapcote Fields, near Hinckley (on the edge of Leicester- and Warwick-shires), by Mr. W. Nurse, with the following note :—

"They are grown upon a black soil (bog); some of the Oats are looking well and are in ear, and others are as the sample I have enclosed. Last year they went the same upon the same piece of land; I thought then it was from the dryness of the season."

These Oat-plants were about six or seven inches high in the leafage, and mostly of a deep green colour, although some of the shoots were yellowish. The shoots were thin and rushy looking (sometimes about six to a root),—not "Tulip-rooted," but having just a small quantity of wrinkled shoots round the base.

On July 5th, Mr. Geo. L. Purchase wrote to me, from Chichester, regarding injury to Oat-plants in the district, and a few days later forwarded specimens and the following note :—

"The attack is very general in this district among spring-sown Oats. Autumn-sown Oats are not attacked. Those sown in April are the worst; those sown earlier are not so bad. In a case of Barley sown with Oats, the Barley is not attacked."

In this instance, as well as the preceding one, the plants were much more rushy than "Tulip-rooted" in appearance, and with very little of the pale yellow doubled and crinkled shoots round the base of the stem which often, or usually, are found round the swollen "Tulip-rooted" base. I therefore, as Dr. J. G. de Man, of Middleburg,—who is one of the leading authorities on *Angruillulidæ*,—was then in England, submitted specimens to him, in order to be certain that the attack was caused by the same kind of Eelworm, namely, the *Tylenchus devastatrix*,—and such proved to be the case.

Cephalobus rigidus, Schneider.—The following observations refer to Eelworm attack found in Oat-plants grown near Milford Haven, in which the plants were found to be infested *not* by the common "Tulip-root"

Eelworm, the *Tylenchus devastatrix* of Kuhn, but by a kind which had not previously been recorded as being found in England, known scientifically as the *Cephalobus rigidus* of Schneider.

The first note of observation of this attack was sent to me on June 28th (with specimens accompanying), from Newton House, Milford Haven, S. Wales, by Mr. Roch Davies, who wrote as follows :—

"I send you a few roots of Black Tartarian Oats for your inspection. The Oats were sown the last week in March; all came up and looked well for a week, when I perceived that large spots in the field seemed to change colour, which I put down to wireworm, but strange to say the plant did not die out, nor could I find any worm. I rolled heavily twice, and at an early stage dressed with one cwt. of nitrate of soda per acre; still there seemed no growth of the spots affected.

"The above was done on April 15th; no other manure was used, and it was rolled again about ten days after, where affected: the plants assumed a dark rich colour, but did not grow, and up to July 5th the affected crop remained (though of a rich colour) only about six inches high. The other portion of the field in a heavy crop, and in bloom. The land is light, rather brashy, and in the old red sandstone formation."

On examining the plants sent me on June 28th, I found them as described by Mr. Davies, very short and of a deep green colour, and, although there was not the decided swelling at the base of the stem which gives the name to "Tulip-root" disease, there was the peculiar plaited or waved appearance of the edge of the leaf which is to be found accompanying Eelworm attack,—in fact sufficient alteration of growth to make me suspect that the injury was due to the action of the Eelworms which I saw were present.

I therefore availed myself of the skilled assistance of Dr. J. G. de Man, of Middleburg, Netherlands, well known for his especial knowledge of this class of nematode worms, who identified the specimens for me as being the *Cephalobus rigidus* above named, and was also good enough to draw from life, and present to me for use in this Report, the figure from which the accompanying excellent plate is taken; and further, at my request, wrote the following account of the attack for the 'Agricultural Gazette' (for July 16th, 1888), in which some of the specially distinguishing points of the attack are scientifically noticed :—

"Miss E. A. Ormerod, Consulting Entomologist to the Agricultural Society, sent me, not long ago, some specimens of Oats, requesting me to inform her whether they were affected by 'Tulip-root,'—i.e., by an attack of *Tylenchus devastatrix*. These specimens presented no more

than a slight enlargement of the base of the stem, but (as she wrote me) some of the leafage had the peculiar plaited appearance at the edge which accompanies this attack, and in one case the plant had distorted, pale, wrinkled shoots, growing in a knot under the plant itself. The sender had reported that the growth appeared quite checked.

"The examination of these plants proved the complete absence of *Tylenchus devastatrix*; but I discovered in the very first plant examined, and then, further, also in the others, the occurrence of another species of Eelworm, viz., of *Cephalobus rigidus*, Schneider. Similarly to what is the case with *T. devastatrix*, large numbers of individuals of this *Cephalobus*, both males and females, adult as well as young ones, and also free eggs (some of which contained living embryos), were found by me in partly-decayed stems, presenting a brownish powdery appearance. In some cases many individuals were also observed on the inner surface of the lower sheaths of the leaves. The Eelworms evidently lived in these plants quite in the same manner, and in the same number of individuals, as does *T. devastatrix* in those plants that are affected by true 'Tulip-root.' As far as I am aware, this remarkable fact has hitherto never been observed.

"But further, according to my opinion, there can now be little doubt that this species ought to be regarded as the cause of the disease from which these Oats were suffering, and that, at least in this country, *Cephalobus rigidus*, Schn., as well as *T. devastatrix*, is injurious to the Oat-fields. *Cephalobus rigidus*, Schn., with which *Cephalobus oxyuris*, Bütschli, is identical, hitherto was only known as occurring in the soil about the rootlets of plants, like the other land nematodes. The *Cephalobi* may be easily distinguished from the *Tylenchi* by the absence of a knotted spear, and by the œsophagus terminating in a rounded swelling (bulbus), containing a simple valvular apparatus. Whereas some species of *Cephalobus* have a bluntly rounded posterior extremity, in *C. rigidus* it is sharply pointed. This *Cephalobus*, therefore, much resembles another form of the same genus, that is also very common about the rootlets of plants, and which I have described under the name of *Cephalobus oxyuroides*; but *C. rigidus* attains a larger size, and presents, moreover, some anatomical differences.

(Signed)

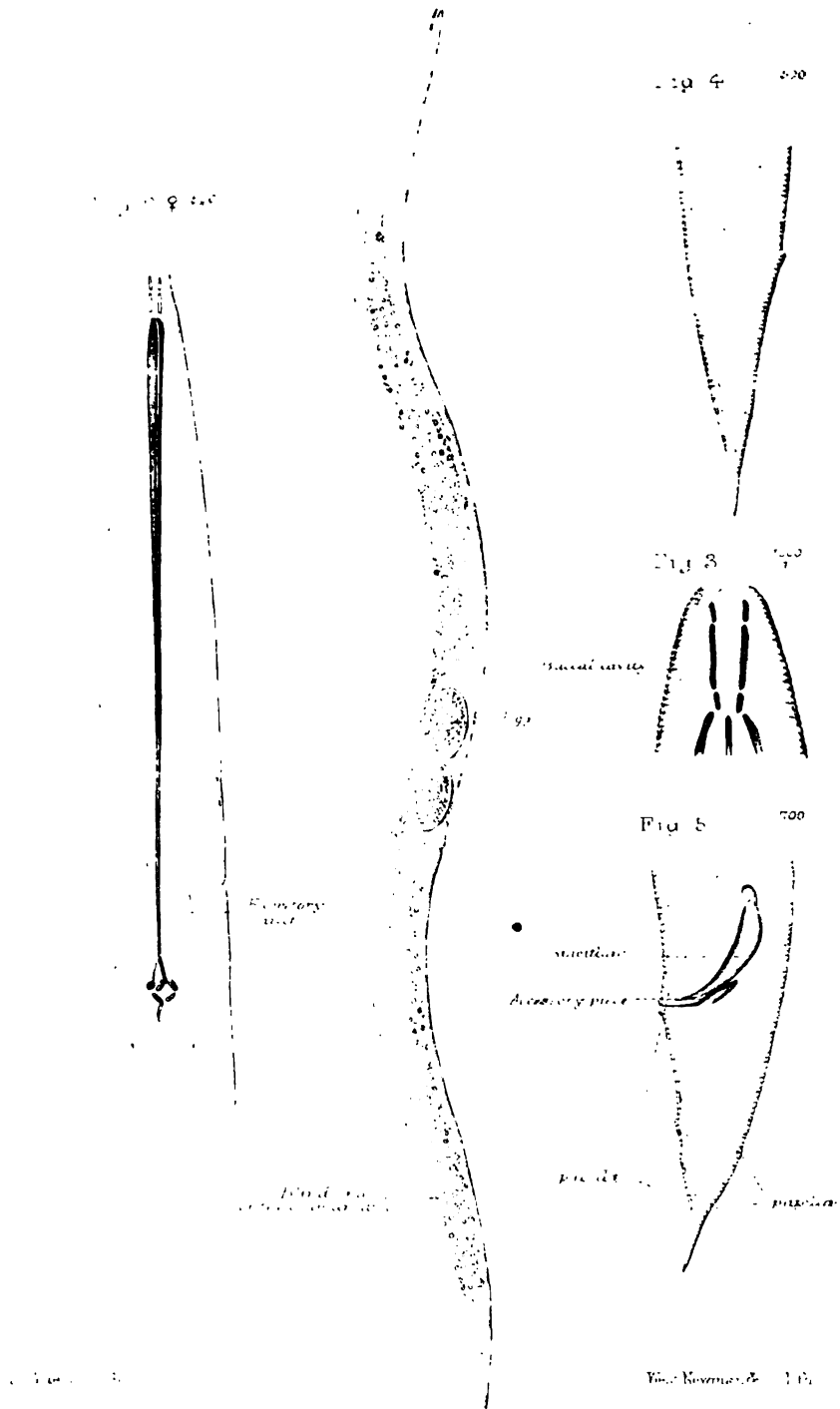
"Dr. J. G. DE MAN,

"Of Middleburg, Netherlands.

"Penzance, July, 1888."

The figures on the accompanying Plate will explain the scientific terms in Dr. de Man's description. Fig. 1 shows the female Eelworm, of which the natural size is little more than one millimetre (that is, little more than one twenty-fourth part of an inch in English

Fig 1 ♀ ¹⁷⁰ lateral view
 Length nat size = 1.3 mm



Caenorhabditis elegans *Schneider*
 Found near plants at Milledale, N. Y., July 1888

measurement), magnified to a hundred and seventy times the original size.

Fig. 2 represents the front part of the same female specimen seen sideways, magnified five hundred times: the "knotted spear," the absence of which is noted by Dr. de Man as one characteristic of the *Cephalobi*, is a sharp process or instrument at the commencement of the *oesophagus*, by which it is supposed that such kinds of Eelworms as possess it prick their food, and thus are able to suck the juices.

Fig. 3 is a side view of the head, showing details of the mouth-opening, and magnified a thousand times.

Fig. 4 is a side view of the tail-extremity of the same female specimen, magnified five hundred times.

Fig. 5 is a side view of the tail extremity of a male specimen, with details magnified seven hundred times.

Dr. de Man gives the description in technical terms in the following

"EXPLANATION OF THE PLATE.

- "Fig. 1. *Cephalobus rigidus*, Schneider, female specimen, 1·18 millim. long, in a lateral view '7°. The ovarian tube extends till near the anus.
- "Fig. 2. Anterior part of the same female specimen, in a lateral view, showing the *oesophagus* with its posterior swelling containing a valvular apparatus, "°.
- "Fig. 3. Lateral view of the head, presenting three out of the six lobes at the anterior extremity and the buccal cavity, '1°°.
- "Fig. 4. Posterior extremity of the same individual, in a lateral view, "°.
- "Fig. 5. Posterior extremity of the male, in a lateral view, presenting one of the two spiculæ and their accessory piece. Some papillæ are also visible on the tail.
- "The transverse striæ of the integument have only been figured on the figures 3, 4, and 5."

The above notes appear to me of great interest: of course in the first observation of a new kind of attack it is of the utmost importance to be certain that the newly-observed insect or worm is the cause of the evil noticed on the plant; and in this case, after very careful consideration, looking at the details of growth of the Oat-plants from about a week after their appearance above ground, and the obvious signs of Eelworm attack present, when sent to me,—together with the fact that this *Cephalobus rigidus* was present in great numbers, and no other kind to which attack could be attributed,—from all this it appears to me, as well as to Dr. de Man, that the attack may be referred to this cause.

Practically considered, the peculiar form of diseased growth which the Oats showed would be well worth looking for in the coming season, for it may turn out that the attack is more present than has been generally known; and if some of the simply "sedged" Oats are infested by this Eelworm, and not by the "Tulip-root" Eelworm, it may give a clue to clearing out the attack in these cases, or to it dying out, without requiring anything to be done to prevent its recurrence on other crops, which might save a deal of trouble.

Wheat-bulb Maggot. *Hylemia coarctata*, Fallen.

The attacks of the maggots of the Wheat-bulb Fly and those of the Frit Fly (noticed at pp. 84—48) are much alike so far as method of injury is concerned. In both cases the maggots feed in the centre of the young growing shoots, and thus destroy them, and the two kinds of whitish maggots also look very similar to the naked eye, but when examined with even a moderately powerful glass the differences may be clearly distinguished. The Wheat-bulb maggot thus seen is whitish, legless, cylindrical, and somewhat lessened towards the head end, which is furnished with two black mouth-hooks. The tail extremity is furnished above with two black spots, which are the *spiracles* (or breathing-pores), by which air is drawn into the very observable *tracheæ* (or air-tubes). Beneath, that is at the lowest part, the tail segment projects, and ends in two square teeth placed centrally, with one pointed tooth, and sometimes more on the outside of the central square pair. These teeth and the *absence* of a little bunch of stalked spiracles near the head appear to me to be the simplest way of knowing the Wheat-bulb from the Frit maggots, but as it may be desirable to have the scientific description I append it below.*

The chrysalids were somewhat oval or spindle-shaped, of a medium shade of brown, with the two spiracles still projecting, and always very plainly noticeable at the tip of the tail, in the form of two little knobs.

The flies are two-winged, and not altogether unlike the well-known Onion Fly in general appearance.

More particularly noticed, they are as described by Mr. R. H. Meade: males with the thorax grey, the sides lighter, and the *dorsum*

* *Hylemia coarctata*, Fall.—"The maggot is cylindrical, a little narrowed in front, glassy and shining. Both the mouth-hooks of equal length." The caudal segment is described as having below four fleshy projections, those in the middle four-cornered with flat borders, the side ones tooth-like; the slope ("abdachung") is similarly set with little teeth of variable form."—"Praktische Insekten Kunde." By Dr. E. L. Taschenberg. Pt. IV. p. 119.

(back) indistinctly striped; the abdomen hairy, oblong, narrow, flat and cinereous, with an indistinct narrow dorsal stripe; anal segment grey; subanal appendages hairy, with two black lamellæ; wings with narrow veins; legs black, with pale *tibiæ*. The females have both the thorax and abdomen pale ash-grey and immaculate, and the four posterior femora, as well as the *tibiæ*, pale.*

The injury to the plants was caused by the maggot feeding within the young stem, and thus causing the death of the infested shoot from the joint effect of the gnawing of the maggot and the consequent decay of the attacked part. The damage that was going on was observed, or at least began to be reported, first, with specimens accompanying, about May 7th, when I found that the maggots, being full fed, were leaving the infested shoots; from this time to May 30th, I received daily, or almost daily, packets of infested plants. Towards the latter part of the month the maggots were turning to chrysalis condition, but the Fly itself did not emerge until the beginning of July from chrysalids which were being kept under observation, though, judging by dates given in German observations, it is likely that it took a much shorter time to develop when in natural circumstances. The first communication on the subject was sent me on May 7th, by Mr. Joseph Drewer, of Weston-on-Avon, Stratford-on-Avon, with the remark—"The wheat-plants I am sending you are taken from a field the entire crop of which is taken by a small grub which you will find in the stem of the plant." These maggots corresponded exactly with the description of those of *Hylemia coarctata*, and were apparently full fed, as I secured the infested plants with some earth, and on May 10th, on examining the earth, I found a good many maggots in it.

On May 10th Mr. D. Tompkins, of Aveley Hall, Romford, reported that he had a field of Wheat which had gone off very much lately, and on examination he found in the thick part of the stalk a small white maggot. These Wheat-plants were about four and a half inches high, and the injury was caused by the maggot feeding in the stem a little above the root.

On May 15th specimens apparently just turning to chrysalids were sent me by Mr. Jos. Paisley, from Waresley, near St. Neots. One of the maggots was slightly changed to a brown tint, and they lay as usual,—that is, in the Wheat-shoot a little above the root, the centre of the shoot being severed and the inside decaying.

On May 14th Mr. Drewer sent further notes regarding the presence of attack, nature of preceding crops, and date of sowing of attacked Wheat. He mentioned that on going over a different part of Warwickshire, on Saturday (May 12th), he found a great number of fields

* "Annotated List of British Anthomyiidae," by B. H. Meade. 'Entomologist's Monthly Magazine,' March 1882.

infested in the same way as his own from which he had sent specimens. He mentioned that he had just sown Barley on his field, as the Wheat was all taken in some places. "The preparation on my field was vetches, fed off with the sheep, and kept ploughed up close to them; and the last week of July mustard was sown, and this also fed off with the sheep. The Wheat was planted the last week in November. As soon as I found it looking bad in February, I well rolled it, then gave it a good dressing of soot, and three-quarters of a cwt. of nitrate of soda per acre. I find this maggot more or less in all my Wheat but that after Beans, and, as far as I am able to tell you, all the farmers about here say the same." "I have a few places attacked in a field of Wheat planted after the middle of December." "Some Wheat I have, after Cabbage planted at Christmas, is quite free from them."

On May 15th specimens of the same kind of grub were sent by Mr. John Saul, from Wainfleet, Lincolnshire, with the note that they were "doing prodigious harm to the Wheat-plant growing in this neighbourhood."

On the following day (May 16th) Mr. Frederic Street, writing from Somersham Park, St. Ives, Hunts, forwarded me specimens of this same kind of Wheat-bulb maggot, some of which were then turning to chrysalids, with the observation that he had been to March, in Cambridgeshire, where Mr. W. E. Russell, of Granford, near March, had given them to him, with the information that "*hundreds of acres* of Wheat were being eaten off by them in the Fens." "The Wheat-plant from which they were taken was growing on fen land after Early Rose Potatoes." In this case the widespread area of attack was shown by the application for information being made by request of a large number of farmers who were suffering serious loss.

On the same day (May 16th) Mr. A. L. Wells wrote from Warren Farm, Witton, near Birmingham, with specimens of Wheat with the maggot beginning to turn to chrysalis inside the stalk. He mentioned that some ten or twelve years before he had suffered very serious loss from similar attack, but had not done so again lately until this year. He also mentioned that one field, sown after Swedes, was "an entire failure, every plant being destroyed for yards together." In reply to my enquiries Mr. Wells further mentioned that the Wheat was sown on December 10th. "Another field, sown after Potatoes, is very thin along one side where the potatoes were got up before they were ripe. The maggot nearly always takes the Wheat much worse after Swedes, and where the potatoes are got up before being ripe; it stands best after Mangolds."

At this date I received daily applications regarding the attack, from correspondents who, it will be seen, speak generally of the serious

injury caused by the maggot. On May 17th Mr. Michael Ellison, of Barber Woodhouse, near Rotherham, Yorkshire, enquired regarding the same maggot, which, he noted "you will find inside the stem of the young Wheat enclosed. I took it this morning from a field belonging to a farm tenant near here, which a fortnight ago was as flourishing as possible, and is now vanishing away owing to the attack of this maggot." In reply to my enquiries Mr. Ellison kindly informed me that the injured Wheat which was on the farm of a tenant, about two miles on the south side of Sheffield, was sown at the previous Martinmas; the land was well farmed, and the tenant gave it half a ton of salt per acre last February. He (the tenant) also said that he had two other Wheat-fields which were much worse, and which were sown the first week in October. Mr. Ellison further observed that "the maggot appears now (May 22nd) to be changing, and the ravages of the insect to be ceasing; so that I hope that the Wheat that does remain will bear more abundantly, as some compensation for that which is lost."

Mr. Ellison's observations are very valuable with regard to the precise life-history of this Wheat-bulb Fly, as he gives the date of sowing of the attacked Wheat, the date when the maggots were turning to the chrysalis state, and in the following letter he reported the appearance of the Fly (which proved to be the *Hylemia coarctata*) from these chrysalids.

On July 7th Mr. Ellison wrote:—"I have now much pleasure in sending, according to promise, a few specimens of the Flies which have hatched from the chrysalids of the maggot that I have previously written to you about, and hope they may reach you safely and well, as I am sending them from here alive." These Flies I identified myself as being *Hylemia coarctata*; but for absolute certainty in the matter, as it is of practical importance, I submitted specimens for examination to Mr. R. H. Meade, of Bradford, that we might have the benefit of his valuable opinion, and he confirmed my view that they were specimens of *Hylemia coarctata*.

Reverting now to reports of observations of the attack in the order in which they were received, on May 17th Mr. Francis Wells, writing from King's Vale Farm, New Oscot, near Birmingham, forwarded me specimens of the same kind of maggot, with the note that it was a sample of a grub which was playing sad havoc in his Wheat. He mentioned—"I must tell you it is Wheat after Swede Turnips, and each year I have sown this succession it has always 'gone off' as it is doing now. One field of mine is a complete failure, and the land is in high condition. The soil here is of a light sandy nature, and if not farmed extra well would soon degenerate into common." The specimens of Wheat sent were about six inches high, and very healthy

in growth. On enquiry Mr. Wells mentioned that it was drilled on January 10th. "The field was manured all alike, and where Swedes grew I think at least three parts of the Wheat is destroyed, and where there were Mangolds and common Turnips it is very little injured." The field was very highly manured for Mangolds, which were eaten on the ground by the sheep. The Wheat was not through the ground until about March 20th. "I quite think with you that the extreme heat of last summer is the cause of the extra devastation."

On May 19th Mr. James Davies wrote me from Hollinfare, near Warrington, with the mention that for several miles around, both in Cheshire and Lancashire, the Wheat-crop in some fields had been greatly damaged, and on some had been entirely destroyed by the attack of which he forwarded specimens, which proved to be again *H. coarctata*, in maggot and chrysalis state. Mr. Davies mentioned that one of his own fields had suffered severely on that portion of it where Potatoes grew last year, while the portion that was cropped with Swedes and Mangolds had escaped. The maggots and chrysalids were found in the very bottom and right in the centre of the stems of Wheat. With regard to the date of sowing and observation of mischief being in progress, Mr. Davies mentioned that his Wheat was sown about the middle of November, and that his fields were very late in showing attack, as he perceived nothing of it until about the last day or two in April, and then not much. Another field in the neighbourhood was sown in October, and the attack was in it earlier and more severely, as the field was resown with Oats in April, all the Wheat being then gone. With regard to succession of crops, Mr. Davies mentioned that in one case a small part of the field that escaped carried Swedes and Mangolds last year, whilst the Potato plot of last year suffered severely.

The following notes from Mr. W. Parlour, of Middle Farm, Dalton-on-Tees, Darlington, are of interest as giving date of sowing of the attacked Wheat, and some special points as to preceding crop or treatment of ground; and also in this case, as well as in Mr. Ellison's, the observation was made complete by the perfect Fly, the *Hylemia coarctata*, being reared from the maggots:—

On May 24th Mr. Parlour wrote me that he had taken the maggots (enclosed), and the accompanying Wheat-plants which had been attacked by them, from a Wheat-field in which they had done considerable damage. This field was sown about October 18th, and the following notes of difference of treatment and amount of attack in the three plots into which it was divided are worth notice:—

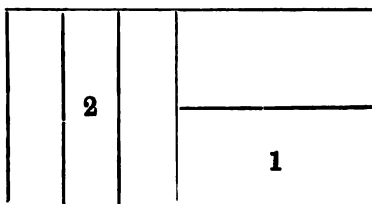
The first plot was sown on Bean-stubble, and was not attacked.

In the second plot nearly the whole of the Wheat was killed by the maggot. This plot had been worked for Turnips, but they were not

sown owing to the drought. It received about four tons of lime per acre, and a large pond that had gone dry was cleaned out, and the mud spread upon this plot.

The third plot was prepared for Turnips in the same way as the second, and received the lime, but, instead of the pond mud, was manured with farmyard manure. Considerable damage was done on this plot, but not half so much as on the second plot.

Mr. Parlour's note of attack on one of his own fields shows such a marked difference in amount on portions differently treated that I give his note *verbatim*, with the accompanying sketch plan of the field:—



"The field was fallow last year, sown with Wheat on Oct. 20th and 21st. All the field was manured with town manure except the corner marked 1; this was covered with mud from a pond that had gone dry. It has suffered much more from the attack than any other part of the field; *it is clearly defined to a yard where the pond mud has been put*. The plot marked 2 has scarcely suffered at all; three years ago it was sown in Tares when the rest was fallow, and in consequence there was a large quantity of couch grass on it at the beginning of last summer, but of course it is all killed now. All the rest of the field *except the headlands* is thinned by the attack." "It rather appears as though the finer and looser the soil at the time of sowing, the more severe the attack, as shown by the Bean-stubble escaping, and also that part of our field which was rough and full of sods owing to the dead couch grass. It also appears that the pond mud has either attracted the Flies, or it has not contained sufficient manurial properties to push on the plant out of the way of attack." Mr. Parlour further noted, "I have examined several fields in the district, and find that *almost all fallow fields have suffered more or less*." "In no case, so far as I can find out, has any Wheat been attacked where the land was cropped last summer."

On July 2nd Mr. Parlour forwarded me specimens of Flies hatched from the chrysalids of the maggots that attacked the Wheat as above mentioned, with the observation that he had "many more chrysalids and they were hatching every day." And a few days later—that is, on July 9th—he sent a further supply of the Flies hatched from the

same set of chrysalids, which I identified as male and female specimens of *Hylemia coarctata*. This observation, joined to Mr. Ellison's, shows the beginning of July to be the time when the Fly comes out. Mr. Ellison's specimens were sent me on July 7th; those from Mr. Parlour on July 2nd and 9th. Amongst these there was a slight difference in colour, some being rather dark-legged varieties of *H. coarctata*.*

The following report from Major H. Salmon, of Tockington Manor, Almondsbury, Gloucestershire, shows the recurrence of this attack on land which had been infested two years before by this Fly;—

On May 24th Major Salmon wrote:—"In May, 1886, you were good enough to investigate an attack on young Wheat which occurred on land in the occupation of tenants of mine in this parish, and to print a notice of the case in your 'Tenth Report on Injurious Insects' (pp. 49 and 50), and I think it may interest you to know that the same attack has reappeared this month in Wheat sown on part of the same large field which is described on page 50. On the part now in Wheat there were *Swedes last year*, and the Wheat is most seriously attacked by these maggots precisely on those spots where the Swedes were observed last year to be very badly attacked by grub or caterpillar under their leaves; in parts where the Swedes were not affected, the Wheat is not affected now. In another field of wheat (on the same farm); but not adjoining the one above mentioned, there were patches of Wheat badly affected by the same maggot (*Hylemia coarctata*). In this field there has been clover for two years, now ploughed up and sown to Wheat." "I also hear of similar attack on another farm more than half a mile off." In the paper referred to Major Salmon gave details of nature of soil and cultivation, from which it appeared that the maggot attack was not found on any part of this field excepting where *Swedes* were grown in the previous year, and that the maggots were incomparably more numerous and destructive in those parts of the field where the *Swedes* failed last year.

The first certain observation of attack from this Fly which was reported to me was in 1882, when young Wheat-plants were sent me at the end of March by Mr. W. Creese, from Teddington, near Tewkesbury, with maggots then feeding inside the stalk, just above the bulb. These larvæ were watched, up to their development to *H. coarctata* Fly, by Mr. R. H. Meade. Mr. Creese then reported that the Wheat-bulb maggot was entirely absent in some seasons, but was very destructive in about three years out of four; that it attacked plants on land that *had been fallowed* in the previous summer, but does

* Mention was made to me that some specimens of *Hylemia* had been considered to be *H. paralleliventris*, but, as I am not aware of this species having been recorded as British, I conjecture that the specimens so named were only dark-legged varieties of *H. coarctata*.

not appear on land ploughed for the first time in the autumn ; also that it *leaves a belt of four or five yards near the edge untouched.*

SUMMARY.—*The result of the above observations appears to be as follows:*—That this Wheat-bulb maggot attack, which was first certainly identified in 1882, though it was apparently present to a serious extent before, occurred last year (1888) at a good many localities mainly in the Midland or Eastern Counties ; notes were daily sent reporting attack on fields or districts, respectively in the neighbourhood of Romford (Essex), St. Neots (Hunts.), March (Cambs.) and the Fens in the neighbourhood, Wainfleet (Lincs.), Sheffield in the South of Yorkshire, and Darlington in Durham, but just beyond the northern border of Yorkshire ; and somewhat more westerly, from near Warrington, on the border of Lancashire and Cheshire ; from two localities near Birmingham, and from Stratford-on-Avon in Warwickshire ; and from near Almondsbury, near the Severn, in South-west Gloucestershire, a locality in which the same attack was recorded in 1886.

The amount of injury is mentioned by various correspondents with regard to fields, as all taken in some places ; as an entire failure, every plant destroyed for yards together ; “ as a complete failure ; and, on a larger scale, as a great number of fields infested ” ; “ prodigious harm to the Wheat-plant growing in the neighbourhood ” ; and in the Fens as “ hundreds of acres being eaten off ” ; also that near Warrington, for several miles around, both in Cheshire and Lancashire, the Wheat-crops in some fields had been greatly damaged, and in some entirely destroyed.

The dates of sowing, which were only given in some cases, were as follows :—Last week in November, and crop looked bad in February ; a few places attacked where sown after middle of December ; first week in October ; Jan. 10th (Wheat not through the ground until about March 20th) ; middle of November, attack not observed till April ; October, and crop destroyed ; resown with Oats in April ; about the 18th of October ; October 20th and 21st ; and at Christmas, planted after Cabbage, free from attack.

Previous crops and treatment of ground.—After Vetches followed by Mustard, both eaten off ; after Early Rose Potatoes ; after Swedes : nearly always takes the Wheat much worse after Swedes, and when Potatoes are got up before being ripe ; “ it stands best after Mangolds.” —A. L. W. “ After Swede Turnips, and each year I have sown this succession, it has always gone off.”—F. W. Attack after Potatoes, a small piece after Swedes, and Mangold escaped. On a field worked for Turnips, and treated with lime, part was likewise dressed with mud from a pond, part with farm manure, much damage was done to this latter ; but on the former, that treated with pond mud, nearly the whole of the Wheat was killed. On another field, treated with town

manure, excepting the square cornered portion marked 1 (see plan, p. 85), which was dressed with mud from a pond gone dry, this portion suffered so much more than any other part of the field that it was plainly observable to a yard where the mud was put.—W. P. Headlands not thinned by attack (and in 1882 it was observed that it left a belt near the hedge untouched). “Almost all fallow fields suffered more or less.” After Swedes that had been badly attacked by caterpillar.

As the attack of *Hylemia*, or “Wheat-bulb maggot,” is one which appears often to be locally troublesome, though rarely—if ever before—to the serious extent to which it occurred in last year (that is, in 1888), I have given the accounts received in almost full detail, as I believe that it is only from notes taken by agriculturists themselves of what occurs to their crops under special circumstances, that we can hope to work out practicable measures of prevention.

Last year was exceptional in its first half regarding many kinds of insect appearance, which may conjecturally be attributed to the peculiar summer season of 1887, peculiarly favourable as it was for multiplication of many kinds of insect. But in ordinary seasons (it appears) that not putting in Wheat after summer fallow—or perhaps one might state it, not putting in Wheat until the summer brood of this *Hylemia coarctata* has passed away—is one means of prevention of this attack; it also appears especially to infest land where Swedes have preceded Wheat, and to be especially likely to occur on land where pond manure has been spread; but with this attack, as well as with the Frit Fly, we need to know where and how the summer brood lives. If we knew where the Flies which we see emerging from the chrysalids about the beginning of July laid their eggs, and where and how the maggots from these fed, we should know how to get rid of the nurseries of the autumn or winter egg-laying, which produces the troubles of the following spring and early summer.

“White-eared” Wheat.

During the middle of the summer—that is, at intervals from about July 6th to August 10th—enquiries were sent regarding the cause of a peculiar attack, which was observed in so many places that it soon was described under the special name of “White-eared Wheat.”

The injured heads, of which many specimens were forwarded, usually seemed at first sight to be all right, excepting being prematurely ripened; but on examination the ears were totally barren, and the top of the stem was usually severed across about three or four inches above the uppermost knot, so that though the injury did not show externally, yet, by holding the lower part of the stem and gently

pulling at the ear, the stem came out of the sheath, leaving a stump behind of a few inches long attached to the highest knot. This stump looked flaccid and shrunken, and at the point of severance, in almost all the specimens sent, the straw was shrunk (and also often brownish, as might naturally be expected from decay taking place at a dead point).

There was no obvious cause for the injury,—neither signs of insect nor of fungoid origin, so far as I could myself make out, or as far as I could learn by consultation, British or Foreign,—nor, although “white ears” are often noticeable in summer in ripening Wheat, could I find that this peculiar fractured stem attack had been recorded before.

In the only instance in which I had a specimen with the attack still in progress, the stem cracked asunder on being pulled (was not already parted), and I found that at the point of fracture the straw tube had an irregular swollen growth within,—what might be described as a granulated growth partly filling up the tube; so that whereas a section of the straw an inch above would have shown a clean, even, fine ring, the section at the point of fracture showed a much thicker ring, smooth and even outside, but inside irregularly swelled or granulated.

The cross section also showed small open cells which had been cracked across in severing the straw. From this appearance it seemed to me that the attack was some kind of vegetable disease, and perhaps due to the wet season acting on local causes.

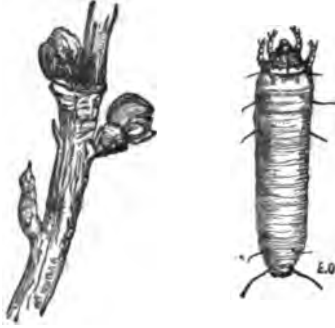
From some of the reports it might be inferred that the diseased Wheat occurred generally, more or less, in the field from which the specimens had been taken, but in some cases the attack was quite local, only affecting a patch or portion of a field.

In one note the attack was stated to be confined to a spot about ten yards in diameter, near an elm tree; in another, only on one land in the field, and that the outside land. In the instance of the attack extending to Barley which I saw samples of, the attack was said to be confined “pretty much to one side of the field.” From these circumstances the disorder whatever it may be, does not appear to have come in the seed; and it certainly cannot be transmitted from seed of the injured plants, as the barrenness of the head is one characteristic of the attack.

But it would be desirable to ascertain what the cause of the disease may be; and if I could have specimens sent to me in the coming season, gathered as soon as the Wheat-ears begin to show the very first signs of (apparently) premature ripening, we could probably very easily make sure of the cause of the injury.

CURRENT.

Current Gall Mite. *Phytoptus ribis*, Westwood.



PHYTOPTUS (? species).*

Black Currant shoots with infested buds. Gall Mite enormously magnified, nat. size invisible to naked eye.

During the past season (as in previous years) notes have been sent of the mischief caused to Black Currant Growers by the attack of the small Gall Mite, of similar nature to that figured above, which injures the Black Currants by causing a swollen and diseased, or totally abortive, condition of the buds.

This *Phytoptus*, or "Gall Mite," multiplies from eggs and increases enormously, and is very infectious, as the Mites can crawl over any part of the bush, or harbour in the rough bark and down at ground level, or may crawl over the ground, or may be carried on leaves by the wind to neighbouring bushes. They are so excessively small that they cannot be individually distinguished by the naked eye, but with a strong magnifier may be found in great numbers in the infested and distorted buds.

The best way to stop attack where it is still slight is to prune off all galled shoots,—that is, those with swollen buds,—and to burn them; also an application of lime and sulphur syringed on the infested bushes has been found of use.

The easiest way to prepare this is to take four ounces of sulphuret of lime and two ounces of soft soap to every gallon of water. The sulphuret and soap should be well mixed together, and the water poured on at *boiling heat*, the ingredients being stirred to make them all mix well together. This mixture may be used (when cool) at any thickness preferred, either for syringing or to run thickly down and

* The above figure is of the Birch *Phytoptus*, and shows the general appearance of the *Phytopti*. I am not aware that distinctions between the form of the *Phytopti* infesting Birch and Currant have been observed.

choke the Mites sheltering amongst the crannies of the branches at ground level.

But where the bushes are much galled it is almost impossible to restore them to healthy growth, and for the sake of saving spread of infestation I believe the most saving course is to root them up and burn them, and fill in the holes temporarily with gas-lime or quick-lime, so as to kill any of the Gall Mites which may very likely be lying on the earth.

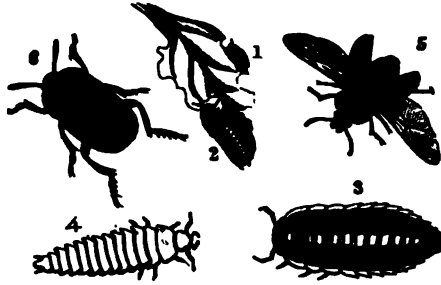
Change of bush crop to something that the Gall Mites will not attack is obviously the best course to adopt, and up to the present time I had no information of the Gall Mite attacking other kinds than the Black Currant. This morning, however (January 15th), I am favoured by a letter from Dr. Friedrich Thomas, of Ohrdruf, Gotha, Germany (a most eminent authority on Phyto-pathology), in which he mentions that the *Ribes rubrum* (that is, the Red Currant—E. A. O.) also is injured by *Phytoptus* bud gall occurring on the stem. Dr. F. Thomas forwarded me, accompanying, a specimen of a stem infested by bud-galls, just in the same way that we know only too well on our English Black Currants, and mentioned that he had observed them for many years in his own garden, but up to the present time no notice of the attack had been practically taken in Germany; likewise that as yet the identity of the species of Gall Mites which cause the respective attacks on the Black and Red Currants had not been made out. However this may be, it is quite certain that the Mites are very nearly related, if not of the same kind, and there is no difference observable in swollen bud growths; therefore the information from Dr. Thomas is very valuable as a hint for watching whether the infestation may appear on Red and White, as well as on Black Currants; and also, in case of importation of Currant-plants from Germany, care should be given to this point.

MANGOLDS.

Beet Carrion Beetle. *Silpha opaca*, Linn.

The Beet Carrion Beetle is very common, and often to be found in small carcasses,—as dead birds, rabbits, garbage, &c.,—and until rather more than forty years ago it does not appear to have been known that its maggot was at times a vegetable feeder. About that date it was first observed as feeding on Beet-leaves in France, and from this circumstance—namely, from its double method of feeding—it takes its common name of the Beet Carrion Beetle. Since then it

has been recorded as doing harm to Mangolds in Ireland, and in 1884 specimens were sent to me from Mageney, Co. Clare, of this Beetle, which was then eating away the Mangold-leaves down to the stems.



SILPHA OPACA.

1, 2, Young grubs feeding; 3, 4, grubs, differing in shape, somewhat magnified; 5, female Beetle, flying; 6, male Beetle, magnified.

Up to this year, however (though the Beetle is common here), we have no records, as far as I know, of either this Beet Carrion Beetle or its maggot being a crop pest in England, and it would be very serviceable if we could make out the cause of its appearance in three widely separated localities in England, as well as of the greater amount of its presence in Ireland.

The first note of the presence of the attack in England was sent me on June 18th by Mr. John H. N. Walford, Ruyton Towers, near Shrewsbury, as follows:—

“ I enclose you some specimens of insects that have entirely eaten bare about three acres of Mangolds for me. They eat the young plants as soon as they appear above ground, and at the same time have destroyed all the annual weeds, which consist largely of chickweed.”

The specimens sent proved to be grubs of the Beet Carrion Beetle. The rounded edges of the first three segments of the larvæ, as contrasted with the sharp hinder edge of those immediately following, were particularly noticeable. A few days later, in reply to my enquiries, Mr. Walford mentioned that he was not aware of anything to account for the attack. The land, which is light and sandy, had been well cultivated in the preceding autumn, and ploughed at the beginning of March. No farmyard manure had been used (because it happened there was not enough), but the manure applied was entirely artificial “bone manure,” a mixture of superphosphate and dissolved bones. Both Mangold-seed and manure were procured from the firms usually dealt with.

With regard to safety of other crops put in on the infested ground, Mr. Walford wrote further that he had drilled Swede-seed since on the

Mangold ground, but did not plough up or cultivate the old ridges. The ground was perfectly bare, and after drilling the Swedes it was rolled with a heavy roller; this operation and trampling killed many of the insects. The Carrots that adjoined the Mangolds on one side were untouched by the grubs, and a small quantity that was eaten off in a crop of Swedes on the other side was considered on investigation to be taken by Flea Beetle, not Beet Carrion Beetle.

On June 15th further specimens of the same kind of grub were forwarded me (by the courtesy of the editor of the 'Agricultural Gazette') from Cwmbran, near Newport, Monmouthshire, with the mention that it was an insect new to the sender, and which was destroying what promised to be a very fair crop of Mangolds. On July 12th specimens of the same grub (namely, that of the Beet Carrion Beetle) were sent me by Mr. Edmonds from Wiscombe Park, Honiton, Devon, with the information that it was doing considerable damage to the Mangolds of some farmers near.

The above observations, it will be seen, refer to attack in England at three places respectively, in Shropshire, Monmouthshire, and Devon; the following refer to attacks in Ireland, respectively in Kilkenny and Tipperary. On June 28th Mr. J. Loftus Bland wrote me from Blandsfort, Abbeylax, regarding attack to his Mangolds, some part of which was caused by grubs of Beet Carrion Beetle, of which a little later he sent numerous specimens of different ages; one of them (which he mentioned as the largest grub which he had been able to secure) was about five-eighths of an inch long.

Mr. Loftus Bland reported:—"I am at a loss to account for the presence of the Beet Carrion Beetle in my land; the manure used was half farmyard, made in covered yards, and half the cleaning of a pond that had not previously been cleaned for over thirty years; also superphosphate (26 soluble) and agricultural salts spread broadcast. No bones, no decaying animal matter."

There is a graveyard (very ancient), in constant use now, on the farm, perhaps some five hundred yards distant from the Mangold fields,—that is the only way I can account for the presence of animal matter to any great extent.

On or about June 19th Mr. D. Sym Scott, of Ballinacourte, Tipperary, Ireland, also forwarded specimens of the Beet Carrion Beetle (*Silpha opaca*) with the following note:—

"From many quarters complaints are rife with regard to a maggot having destroyed large breadths of Mangolds: it is a black maggot, nearly three-quarters of an inch in length, and to the writer a new enemy of that plant."

These grubs were forwarded on to me, and by that time some of them had (as with another consignment sent me) been apparently

exercising their cannibal propensities by feeding on each other, as there were broken remains of skin of other *Silpha* maggots in the box. At this date, on examining some of the specimens previously sent me, I found they were looking in extremely good health, and of a bright shiny black, and, as the Beet-leaves enclosed with them were faded, and I usually found some of the grubs under, or by the portion of a chicken's leg which had become partially putrid, I conjectured that—as they had no longer Beet- or Mangold-leaves in a state suitable for food—they were feeding instead on the putrid meat (or “carriage” from which they take a part of their name. Five days later one or two of the grubs were dead, but others, which were not observable until I stirred the soil, were lively and apparently thriving.

The following notes, also by Mr. D. Sym Scott, convey information regarding the time of attack,—namely, that it is chiefly carried on at night, and the plant-feeder consequently not at once observable; also that the later-sown Mangolds were not so badly injured as the others, by reason of the grubs being at that time nearer the date of their change to chrysalis state; and also full notes are given of the method in which the grub attacks leafage.

As we were not fully informed on these points, I requested information on them from Mr. Sym Scott, as a well-skilled and long-accustomed observer, and in reply he favoured me with the following useful notes:—

“With regard to injury done to Mangold-crop by larvæ of *Silpha opaca*, several farmers in this locality have suffered, myself among them. For some time I could not make out what was wrong with the plant, and (with others) blamed frost at night; but one morning before the dew was off I detected the insect at work, and reported this to others, who also found them. This confirmed my suspicion about an insect, and I also saw that the insect *fed only during the night, or when the leaves were moist*; when the sun was up strongly they buried at or near the root of the plant, which accounted for my not seeing cause of failure sooner. The attack only affected the early sown, which leads me to believe if we do not sow till May, the season of attack will be over before the plant appears above ground. It was on the most sheltered side of my field the attack was most severe. On this side of the field the crop is ruined, but on the more exposed part the plants are recovering.

“No bone or any artificial fertilizer were used, either here or elsewhere, in this part, nor have any been used for years past, so that bone manure is not the cause. I use only farmyard, and that of good quality, same as used for years. I have further to say that the soil on the different farms is in each instance different; the treatment here

same as for past years; the seed was even got from separate firms,—mine was got in Plymouth, the other Dublin and local.

“I was at one time inclined to think the cause lay with the manure from fattening houses, as it sometimes contains ill-digested Indian corn meal, which might attract the maggot, but on a neighbouring farm where they use similar food no attack was found. I have taken some pains to find out a cause, but failed, unless we take climatic influences; last summer was the driest on record within sixty-one years,—it was followed by a remarkably mild winter and spring. Could this have anything to say to their presence? It might, as I remarked the Turnip Fly much earlier than usual this season; others have made the same remark. If spared next year I will knock about the Mangold a few wild pigeon, rooks, hawks, or similar vermin, which we generally shoot in spring, and try what effect feeding will have. I hope, however, I shall have no more of them, as my Mangold are entirely ruined this year.”

In reply to my enquiry whether he could give me a precise account of the method of the attack, Mr. Sym Scott wrote me, on August 18th, as follows :—

“I have too good reason to be able to say how they attack the plant, as they left me but a sorry show for a crop of roots. The maggot attacked the young leaves much in the same way as the Turnip Sawfly, eating them completely down to the surface of the soil. They fed mostly during the evening and early morning, burying at the roots of the plant during the heat of the day. When the leaves were eaten off, the maggot attacked the tender root, and on the part of the field here first attacked the root was gnawed off about a quarter of an inch beneath the surface of the drill. On this portion of the Mangold not one escaped. On the upper part of the same field the leaves only were eaten, so that most of the plants, though late, are growing. My opinion of this is, the lower part of the field being attacked early, the maggot completed the destruction of the entire plant, but *the season of attack was over before the leaves on the upper part of the field were all eaten*. I could pull up a handful of short stumps of the plant on the badly affected portion, clearly showing that the plant was eaten down to the ground, and the root under the surface. I used to dig up numbers of maggots to show to interested parties, from the holes where the plant grew.”

SUMMARY.—Looking now at the main points of information to be gathered from the above reports, it appears, first, that the dates of attack ranged from before June 18th (when the grubs had already eaten off three acres in one locality) to July 12th, but by June 19th many of the grubs had attained almost their full size; somewhat under three-quarters of an inch in the Tipperary district. Secondly,

the grubs feed on the leafage, but, failing this, go down and feed on the roots, gnawing them off about a quarter of an inch below the drill. Where this happens of course the plant dies, but where the leaves were only eaten back (it was observed by Mr. Sym Scott) most of the plants, although late, recovered. This point is very important practically, and attention was drawn to it some years ago by John Curtis, as a reason for *not clearing off a damaged crop over hastily*, for as soon as the grubs are full grown they stop eating, and if the plants have life in them they will at once make growth. Also (as noticed by Mr. Sym Scott) attack will suddenly cease on a crop simply from the time of *change of the grubs to chrysalis state being come*, and all the damage consequently being over.

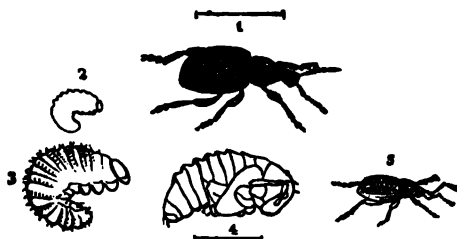
As the grubs go down into the ground to about three or four inches below the surface for the change to the chrysalis state, it would be a good means of preventing recurrence of the attack to disturb the surface, so as to throw these chrysalids out to be killed by exposure or by the birds. If all goes on naturally, and the grubs are left undisturbed, the Beetles would come up from the ground in about three weeks after the maggots went down. There appears not to be always a clear idea with regard to this insect as to whether it is a Beetle or a grub: this probably arises from its dark colour in grub as well as in beetle state, but a glance at the figures at the head of this paper will show the very different form. The grubs sent me mostly resembled the figure in outline at 4; they were as they reached me not so broad as 8, and were chiefly of a deep blackish tint. They have a pair of horny jaws, and three pairs of small legs.

The Beetles are flattish, brown-black, slightly downy, and have three raised lines along each wing-case, and are to be found (as I mentioned in my Report for 1884, p. 61) during winter or early in the spring, sheltering under clods or stones, or in moss and rotten wood, and are common in April in dead animals.

There does not appear to be any reason to suppose that this attack affects other field-crops than Beet or Mangold, although in one instance weeds appear to have been attacked in the infested field. Turnips and Carrots on the two sides of infested Mangolds escaped injury, and, judging from what has been recorded before, there would be no reason to fear danger to other crops put into infested ground, even when attack was known to be present, or *immediately* after attack. Besides Turnips and Carrots above mentioned, Parsnips, Potatoes, Peas, Beans and Cabbage have been recorded as all succeeding perfectly on land where the Mangolds had been destroyed.

RASPBERRY.

Black Vine Weevil, *Otiorhynchus sulcatus*, Fab.
Clay-coloured Weevil, *O. picipes*, Fab. (*septrionis*, Steph. Man.)



O. SULCATUS and *O. PICIPES*.

1—4, *O. sulcatus*, maggot and pupa, nat. size and magnified, or with lines showing nat. length; 5, *O. picipes*.

The two kinds of Weevils—scientifically *Otiorhynchus sulcatus* and *Otiorhynchus picipes* of Fabricius, figured above, have an enormous capacity for doing mischief. In beetle state they feed on leaves and shoots of various plants, amongst which Vines, Raspberries and Strawberries may especially be mentioned, though unfortunately the list might be much lengthened, and sometimes includes field root-crops, of which an especial instance came under my notice in 1885, when the two above-mentioned kinds greatly injured twelve acres of Mangolds.

Their habits and means of prevention and remedy have been so often entered on that they are only now mentioned again relatively to a particularly bad attack of the smaller kind, the "Clay-coloured Weevil" (*O. picipes*), which occurred in a Raspberry plantation in Kent, and of which mention was sent to me, with specimens of the Weevil accompanying, on May 28th, by Mr. Arthur Beale, from Covent Garden Market.

Mr. Beale wrote :—" I enclose herewith some specimens of a Beetle that does considerable damage to Raspberry-cane, in some instances completely killing the plant by biting out the buds and young shoots. I brought the enclosed specimens from a plantation in Kent on Saturday, but omitted to bring any of the plants ; I could get them if you wished it, but expect it is sufficiently common to be well known. We have been killing great numbers by smoothing the ground round the plants, and then laying a few large clods about, under which we usually find large quantities the next day, and so destroy them ; but this we find a costly and tedious cure, and wish to know if any other remedy can be suggested."

The habit of life of these Weevils is to lay their eggs a little below the surface of the ground ; from these eggs there hatch legless, whitish, fleshy, and somewhat hairy maggots (see figure), with yellow or ochrey heads and jaws, by means of which they do great damage to the roots of the plants at which they are found.

The maggots may be found in the ground, as in Vine borders, or at the roots of Raspberries for instance, from August onwards, and in the spring—that is about April—they turn to chrysalids in the ground not far from the surface, the depth probably varying with the kind of soil. From these chrysalids, which much resemble the beetles in shape, but have the limbs folded beneath them, and are whitish or yellowish, and without power of movement until fully developed into Weevils, change to this state soon takes place.

In some cases attack may be checked by disturbing the soil in the winter, so as to turn the maggots out, or at least break up their shelters ; for though it does not hurt them to be frozen hard in their own chosen sheltering-places, exposure both to wet and cold will get rid of many.

The Beetles, or Weevils, are of the shape and size figured at 1 and 5. *O. sulcatus* is of a dull black, the fore body granulated ; the wing-cases furrowed and spotted with pale hair-tufts. *O. picipes* is smaller, and more of a reddish brown or clay colour, whence its name. These Weevils are wingless, which is an important matter in getting rid of them. They feed at night, and when out on the shoots of Vines, &c., if a light is suddenly flashed on them they drop to the ground, and for in-doors prevention—as in vineries—this plan may easily be carried out.

With regard to out-of-door plants it is more difficult ; but with regard to Raspberries, where they are arch-trained, the Beetles may be got rid of by sending men into the plantations at night, furnished with lanterns and light wooden trays smeared with tar. One man holds the tarred tray beneath the arch, and the other carrying the lantern gives the bush a smart tap, and thus the Weevils fall on the tar (which of course needs frequent renewing) and are caught and killed. This plan has been found to answer excellently on a large scale, but to carry out it is necessary that the plants should be arch-trained.

Where this cannot be done, the plan mentioned by Mr. Beale of laying clods or anything under which the Weevils will shelter, and which thus can be used as traps, seems, though expensive, almost the only remedy practicable.

SPARROWS.

The observations of the "Sparrow nuisance," as it is well described, continue to show the same points which are observed year by year,—namely, loss from depredations of this bird on fruit-tree buds, &c., to fruit farmers; on young crops or vegetables, as peas, &c., in gardens; and deplorable loss where the birds flock to the standing corn in autumn; and, further, the increasing and widespread evil which is threatened through Sparrow persecution of our most valuable insectivorous birds.

As every farmer throughout the country is well aware of the damage done to his crops, it does not appear necessary to go over details again which have been so often given, though they are not wanting both from farmers and fruit-growers, and in my own garden I have had full opportunity of watching the feathered pests doing damage, whilst at the same time they left the insect pests unharmed on the plants amongst which they—the House Sparrows—were feeding.

But independently of all this serious loss, it is very important to draw attention to the increasing evil of *truly* insectivorous birds being driven away by the Sparrows. Personally, whilst I still lived near Isleworth, I found the Martins which had built plentifully under the eaves were driven off, so that nesting ceased consequently on the increase of Sparrow presence.

Mr. Reginald W. Christy, of Boyton Hall, near Chelmsford, wrote me last year (1888) on this subject:—"The effect of Sparrows on our Swallows and Martins is very marked here: the latter seldom or never bring off young ones. As soon as they have built their nests, the Sparrows come and drive them out and lay their own eggs in them. Both Swallows and Martins are pretty plentiful at first, but they go elsewhere to breed, and as a consequence, we swarm with all kinds of noxious gnats and flies."

Relatively to this point of trouble, caused by Sparrows driving away insectivorous birds, Mr. Ralph Lowe, of Sleaford, who for years attended to the subject, wrote me, in 1885, that at the Moat House, Leake, Boston, Lincolnshire, flies were a pest to such a serious extent that the occupier took my advice *literally*, and *pretty well destroyed the Sparrows*; the Swallows and Martins consequently established themselves in large numbers, and the *pest of insects ceased* to be destructive in garden and orchard.

In June of last year Mr. Champion B. Russell, of Baldwins and Stubbers, Essex, continuing communication with which I had been favoured by the late Col. Russell, of Stubbers, for some years, sent the following observation, which, it will be seen, shows presence of

Sparrows in droves, but *not of Martins*, at Baldwins, where Sparrows had *not* been looked after, and, on the other hand, *presence of "hundreds" of Martins* at Stubbers, where, as is well known to all interested, Sparrows had been kept in check for a long series of years :—

Mr. Champion Russell wrote :—" When I came to my farmhouse (Baldwins) last autumn there were thousands of Sparrows." . . . " I have not yet persuaded any Martins to come here, although I have put up foundations to look as if Martins had been there before. This is curious as Stubbers is scarcely a mile away, where there are hundreds."

In answer to an enquiry which I wrote to Mr. J. H. Gurney, Jun., of Keswick Hall, Norwich, as an ornithological observer, he mentioned that he could testify, from personal observation, that the Sparrows drive away the Martins, and that he considered the undoubted decrease of this species in the British Isles to be due to their being prevented from nesting by the Sparrows.

I have other notes sent in as to Sparrow mischief, but it is perhaps better to use space, in a short account of what is happening, where these destroying birds have reached the unbearable amount of increase to which they appear to be quietly advancing here.

In the Report of Dr. C. Hart Merriam, Ornithologist to the Department of Agriculture, U. S. A. (published in 1887), he gives details of the spread and baneful effects of the presence of this bird,—which are well worth studying,—and he officially recommends the immediate repeal of all existing laws which afford protection to the English Sparrow, and, amongst other helpful suggestions, advises the enactment of laws making it a misdemeanour punishable by fine or imprisonment, or both, to intentionally give food or shelter to the English Sparrow, except with a view to its ultimate destruction ; to introduce or aid in introducing it into new localities ; or to interfere with persons, means, or appliances engaged in or designed for its destruction, or the destruction of its nest, eggs, or young.*

* What may be desirable in this country as to legislation is equally beyond my knowledge or wish to express opinion on, but it certainly would make a difference if heads of families would interfere regarding the widespread habit of specially feeding these birds. As well said by Prof. W. Frearm, of the College of Agriculture, Downton, in his paper on Bird Pests, given in the ' Mark Lane Express ' for November 12th, 1888,—If the winter should be severe " many humane hearts will feel for the birds, but unfortunately it is the ' poor Sparrows ' that usually come in for much misplaced commiseration, and for liberally scattered crumbs. The small insectivorous birds, true farmer's friends, are not thought of. If they were, then some shreds of meat might be strewn for their benefit, and so they might be helped through a season when their natural food is almost unattainable. It is true that the Sparrow would appear at this feast, because he is an impudent, greedy, bullying little creature, who will eat anything, whilst the useful insectivorous bird has no palate for bread-crumbs."

I have also received from Prof. Riley, Entomologist of the Department of Agriculture, U. S. A., a paper published by him in the 'Northern Tribune' (April 26th, 1888), containing the substance of a communication submitted to the Biological Society of Washington, regarding contents of stomachs of Sparrows.

Under this description "is included not only what is taken from the crop, but that taken from the gullet and mouth."

From the length of the paper—which, besides the anatomical investigations, includes a very large amount of careful scientific and practical observations—I cannot give it here; but the result of the whole is conveyed very plainly in the title under which the paper is published:—

"THE BRITISH PEST.

"Worthlessness of the Sparrow as an Insect-killer." By Prof.
C. V. RILEY, Entomologist Agricultural Department.

In Canada, at the Annual Meeting of the Entomological Society of Ontario at Ottawa, Mr. J. Fletcher, the Dominion Entomologist, took occasion to refer to the injuries inflicted by the English Sparrow, whose *destruction he strongly advocated*; and the Hon. C. W. Drury, Minister of Agriculture, who attended the meeting as head of the Agricultural Department of Ontario, expressly to show the importance attached by the Government to the work of this Society, stated in reply to Mr. Fletcher "THAT THIS DESTRUCTIVE BIRD WAS NO LONGER UNDER THE PROTECTION OF THE ACT OF PARLIAMENT RESPECTING INSECTIVOROUS BIRDS, AND THAT EVERYONE WAS AT LIBERTY TO AID IN REDUCING ITS NUMBERS." This on October 6th, 1888.

In South Australia, where the Sparrows are a grievous evil, the Royal Agricultural and Horticultural Society are taking the matter up by offering prizes and rewards for its wholesale destruction. On November 12th, 1888, Mr. Albert Molineux, Member of the Society and Editor of the 'Garden and Field,' and a valued correspondent of my own, forwarded the following note of arrangements:—

"SPARROW DESTRUCTION.—At a meeting of the Sparrow Destruction Sub-Committee of the Royal Agricultural Society, held on Wednesday, November 7th, it was resolved to supplement the already liberal prizes to be offered at the Autumn Show for Sparrows' heads and eggs. The prizes consist of £2, £1 10s., £1, 15s., 10s., and 5s., for the largest number of heads, and the same amount for the largest number of eggs. The Sub-Committee having received a sum of £5* from Miss Eleanor A. Ormerod (Consulting Entomologist to the Royal Agricultural

* I am unwilling to publish my own name connected with any trifling contribution in furtherance of any object, but in this case I have done so, as the strongest way in which I could show my belief of the urgent need of action,

Society of England), in aid of what she terms the laudable object of destroying this crying pest, and having also resolved to collect a fund by public subscription to effect this purpose, if possible, have determined to give 2s. 6d. to each competitor who fails to secure one of the above prizes and yet brings not less than 100 heads or eggs, and to all others who bring in not less than 50 heads or eggs they have decided to give a reward of 1s. In all cases they demand that the heads shall be on strings or wires, of twenty-five each, and must have been put into a strong brine of salt and water."

Mr. Molineux, who is himself a member of the Sparrow Destruction Sub-Committee, informed me further that now attention was roused, and the boys were routing out the nests and killing the Sparrows "wholesale," and it was believed that a great number would be got rid of.

The above notes give some idea of what is going on about this well-called "nuisance" the *Passer domesticus*, or "House Sparrow," and it might lessen the difficulty of getting the matter attended to if it was fully understood that under this name no other kind of bird is included, and that it is distinctly different from the "Hedge Sparrow." There are some very vague ideas abroad on this subject, and so much communication is sent to me on the matter of Sparrow mischief that I feel bound to point out—besides the grievous waste to our crops, gardens, and fruit farms—how serious a matter it is that, whilst the increase of kinds of fly pests of our corn-fields is so observable as it has been in 1887 and 1888—a regular means of lessening the number of our best and most helpful insectivorous birds should go unchecked.

Space does not allow me to go into anything like the detail which would be of service in this matter, so I therefore append a list of publications in which information of a sound, well-founded, and serviceable nature, from trustworthy writers, is given.

I also take leave to add that, through the kind courtesy of Mrs. Russell, widow of the late Col. Russell, I have been presented with the series showing (in preserving fluid) the contents of the Sparrows killed for examination during many years, the dates of examination (showing the steadily continuous method of observation, month by month and year by year) being often given; and to those interested in the subject the series affords a very instructive general idea of amount of grain consumed.

References to Works where information will be found on Habits of the House Sparrow.

"Report of Committee on the House Sparrow rendered to Council of American Ornithologists' Union, April 21st, 1885; being Report of Results of Investigations over allotted sections of the entire United States and Canada." Procurable also in the Number of 'Forest and Stream' for August 6th, 1885; published at 89, Park Row, New York, U. S. A., or through English booksellers.

"Report of the Ornithologist to the Department of Agriculture, U. S. A. (Dr. C. Hart Merriam) for the year 1886." Published at Washington, Government Printing-Office, 1887.

Paper by Prof. C. V. Riley, Entomologist to Department of Agriculture, U. S. A., on "Contents of Stomachs" of Sparrows submitted to Biological Society of Washington. Substance given by Prof. Riley in the 'Northern Tribune,' April 26th, 1888.

"Observations by Lieut.-Col. Russell, J.P., D.L., of Stubbers, Essex." Read before the Essex Field Club, and published by that Society in their volume for 1882. Buckhurst Hill, Essex.

'The House Sparrow.' Published by Messrs. Wesley and Son, 28, Essex Street, Strand, London, W.C. This is a small 8vo. vol. of 70 pages, containing excellent information, with tables of food of adult Sparrows during each month of the year; also up to the time of leaving the nest, and other serviceable matter.

In my own Eighth and Ninth 'Reports on Injurious Insects' (Simpkin, Marshall and Co., Stationers' Hall Court) I also give reports on this bird.

WARBLE.

Ox Warble Fly. *Hypoderma bovis*, De Geer.



HYPODERMA BOVIS.

During the past season the subject of Warble prevention, both as a matter easily carried out and also as one of serious importance, has made great advance. The leading Agricultural Societies, Societies and Companies more especially concerned with the sale of hides, land-owners and cattle-owners, and the agricultural and also the general and local press, have all helped heartily, and the result has been excellent and not confined to this country.

Here I have had communication from every one of the English counties, and likewise from various localities in Wales and Scotland, and especially from Ireland; and information has been sought from various localities on the Continent and from N. America. Besides much information asked for by letter, which I have always endeavoured to attend to as promptly and as fully as I could, I have distributed somewhere about 28,000 of my four-page leaflets with life-history and method of prevention and remedy of Warble attack, in addition to about 40,000 previously distributed: and Messrs. W. Murray and Sons, hide factors of Aberdeen, N. B., also made arrangements to have 15,000 of this leaflet printed at their own cost, and distributed free to all the agricultural servants and those interested in cattle management who entered the show-yard at their Annual Show at Aberdeen on July 19th. The Exhibition by the Newcastle Hide Inspection Society (Mr. J. McGillivray, Sec.), at the Royal Agricultural Society's Show at Nottingham, did much good, as well as that at Newcastle-on-Tyne in the previous year.

The plan adopted of displaying badly-infested hides when newly removed from the animal, so as to show the under surface and its horrible condition with the great maggots working in their putrid cells, has proved to be one of the best methods of drawing attention to the great injury caused to the living animal. Besides these, tanned hides were so shown that visitors might see how they were riddled by the maggot holes, and the maggot and fly were also exhibited, and all

necessary information given to visitors by a member of the Inspection Society, or one of their *employés*. The Nottingham Hide Market Co. (Mr. W. Welbourn, Sec.) helped cordially and most serviceably by supply of fresh hides, and also by distribution of posters and hand-bills with short and clear directions for Warble prevention. The same kind of arrangements were adopted at other agricultural shows with excellent effect, and the great thing now needed is to carry on the work so that those not yet reached may be *obliged* to know the nature of the attack, and that it can for all practical purposes be stamped out by *each man amongst his own cattle*.

Last year was an excessively bad one for Warble attack where cattle had not been looked to, but (as will be seen by the reports sent in) even under these circumstances it was slight where preventive measures had been taken.

In the following pages I give (mostly in my correspondents' own words) notes of the applications which have been used, and results also of the continued benefit to the cattle in Bunbury district, Cheshire, where preventive measures have been carried on now for several years; some notes showing sickness and death where cattle were neglected; and also returns with which I have been favoured from leading Societies, Firms, Hide-market Companies, and others, showing amount of hides passing through their hands in the course of one year, with estimates of the proportion amongst these that have been warbled, and consequent depreciation in value. These are given by permission, with the names of the senders, to whom I am greatly indebted for their courtesy in furnishing me at my request with such valuable help towards forming an estimate of the amount of money lost yearly on hides only by this quite needless pest.

The following notes refer to various kinds of treatment and applications found serviceable, during the past season, in destroying the maggot or preventing summer galloping,—with observations of the senders both as to the satisfactory effects of treatment and to the great need of it.

On May 26th Mrs. Holford, of Castle Hill, Cerne, Dorchester, wrote as follows:—

“I can now give you the results of following your directions last season about the Warble Fly. In the dairy herd of thirty-two cows we have only found seven maggots; in the other, forty-one head of all ages, only three animals have any, though I expect to find more after a few days of this warm weather. Needless to say I shall continue your treatment.” Mrs. Holford further mentioned:—“I have said nothing of our short-horn herd as they are quite free, and, having sheds to go into when the fly is about, do not run the same risk.” This point is very important because (as I have noted on the fourth

page of my Warble leaflet) "Warble Flies are most active in heat and sunshine," but commonly the shelter of trees is the best that can be hoped for.

On May 26th Mr. James Phillips wrote to me from Carse, Kirkcudbright, N. B., regarding the application of McDougall's dip:—

"I think the remedy you recommend in McDougall's dip must be effectual. This last spring I had a bullock infested with lice, and to rid him of the vermin I had his back completely washed with the said dip, about the end of March. Since receiving your advice I have examined him carefully, and find that I have 'killed two birds with one stone,' as on him neither maggot nor oell is to be found, although on the backs of his neighbours in the same field there is abundant evidence of the pest being still in winter quarters, or in some cases signs are not wanting that the unwelcome guest has lately taken his departure."

The following report from Mr. F. C. Smith, of Clayton Park Square, Newcastle-on-Tyne, who bestowed much time and trouble on drawing attention to the subject of Warble prevention, was sent me on June 4th:—

"I lately met Mr. James Renton, tenant of North and South Brackley farms, near Blagdon, to whom I gave a copy of your notes about a year ago, and who then told me that his stock—numbering about forty head—were infested with Warbles. He forthwith commenced to use a dressing* composed of train oil and sulphur, of the consistence of thick cream, which he applied to the Warbles with most excellent results; and later on, in August, he dressed them with the same preparation,—over the shoulders, and along the spine, and down to the hocks."

He reports that no Warbles are upon stock of his own breeding, although he has had much trouble with *Irish* stock brought to fatten off; and that many of his neighbours are in a bad way with their stock suffering from Warbles, and these people are now going to adopt the same remedial measures as my informant has proved to be so effectual. "Mr. R. in the future intends to dress his stock in May and August, and blesses the day upon which he got your 'Notes,' as his stock are now undisturbed by Fly and thriving apace."

On June 14th Mr. Ernest Mead, who had communicated with me before on the subject of Warbles, from 1, Western Road, Tring, wrote as the result of his application of oil and sulphur to the back of cattle in the previous summer:—

"As regards some three-year old bullocks that were dressed, I have

* Mr. Renton says that a gallon of train oil, costing three shillings, and sulphur, costing say threepence, was sufficient to dress thirty-two head once.

kept some of them till quite recently. After examining them several times I have not seen a trace of Warble."

At the same date as the above Mr. John L. Hewer, of Copthorne Villa, Dymock, Gloucestershire, favoured me with the following note regarding effects of squeezing out the maggot, and also of application of the dip:—

"I followed your instructions with the two worst cases,—squeezed the grub out where possible, and put some dip on the remainder, and am very pleased to tell the result is quite satisfactory. My impression now is that I used the dip last year much too thin; this time I have used it very much thicker, and the cattle are quieter and do better than last year."

Mr. D. Sturdy, of Trigon, Wareham, Dorset, writing on June 16th about Ox Warble Fly, mentioned that—

"As it has been continually persecuted here from the time you first wrote about it, there are very few to be seen. My men have become very expert at pricking the maggot with a needle, and we depend more on that than dressing, which is rather a business with 150 head of cattle. At the same time I found the various dressings very effective in years gone by."

Of course whatever is the cheapest and surest way of getting rid of the maggot is the best, but I have been afraid of advising pricking them, as it takes some care and practice to perform the operation dexterously. I have known the cattle to be put to pain when the prick was not quite properly given.—Ed.

The following observations, with which I was favoured on June 5th, by Mr. Gerard Meynell (of the Norfolk Estuary Company), writing from 20, Whitehall Place, London, S.W., refer to the successful use of Calvert's carbolic sheep-wash for destroying Warble-maggot:—

"For some years past the sheep on this Company's farm at Lynn have been dipped in a solution of Messrs. F. C. Calvert & Co.'s carbolic sheep-wash,—80 to 100 of water to 1 of the carbolic wash supplied,—which has effectually kept them free from all scab, lice, ticks, fleas, &c. Last week I examined the Company's herd, and found some of them affected with Warbles. I had a somewhat stronger solution of the carbolic sheep-wash applied to the parts affected. On the following day all the Warbles appeared to be dead; the more mature ones certainly were so."

Mr. J. Stewart Peter, of Calley, Bridge of Calley, Perthshire, on June 20th sent me the following note, suggestive of dilute carbolic acid being in some cases better than greasy applications:—

"I have dressed a number of short-horn crosses as directed, and feel sure that they will derive great benefit from it. I rather object to dressing my West Highlanders, though, with an oily or greasy

mixture, as it will mat their shaggy hair and prejudice the English buyers against them when they come north in October. I think for them carbolic acid and water ought to suffice."

This point, that is, effect of different treatment on the very shaggy breeds of cattle, would be well worth special observation, for besides notes received from Mrs. Holford, of Cerne, Dorsetshire (p. 105) of treatment of her different herds, she mentioned a case to me of two Highlanders, of which one was treated for Warble by the maggots being removed; this when killed (three weeks after) was found to have the hide healing quite satisfactorily. The other, which had the maggots destroyed in the hide, when killed (six weeks after) was found still to have some amount of inflammation present. It occurred to me as possible that the shaggy hair might clog together into a mass over the Warble-hole, and so prevent the proper discharge of the putrid contents.—Ed.

On June 26th the Hon. G. E. Lascelles, of Sion Hill, Thirsk, wrote me :—

"I have tried paraffin and sulphur on my milk cows (twenty-five) last summer, and this year have hardly any Warbles amongst them, and am now dressing with cart-grease, McDougall, and sulphur, with a little spirit of tar, every beast on my farm,—about a hundred, some twenty brought in being very full of Warble."

Mr. Lascelles added, that strongly pressing the importance of the matter upon all stock-owners was doing good service to the agricultural interest.

About the same date (June 27th) Mr. Saml. B. Sherwood, of Hazlewood Hall, Friston, Saxmundham, wrote :—

"I caught all my cattle a few days since and dressed them with McDougall's smear for bots, and only wish I had done it before;" and on the same day Mr. G. Thomas, of Coosenwartha, Scorrier, Cornwall, wrote that, "thanks to the advice and use of preventives," my cattle are entirely free from Warbles, and I shall never allow them to go undressed again.

"I found wheel-grease too strong, as it blistered. McDougall's dip proved excellent, but it is difficult to procure here as there are no agents."

The following note, sent me on July 5th by Mr. John Watson, jun., from the Estate Office, Sherburn, near Tetsworth, also mentions serviceableness of McDougall's smear :—

"I have been making use of your advice about Warbles with most satisfactory result. McDougall's smear is an excellent cure as well as preventive, and I am sure the trouble and expense is well repaid by the increase in the animals' comfort."

Mr. John Bulteel, of Painfleete, Ivy Bridge, Devon, also mentioned

that, by following the advice given, "the Warbles in the skin of my cattle have quite disappeared, and fifteen cows are now grazing in the meadows without a symptom of discomfort."

The two following observations refer to successful use of ointment prepared by the Dee Oil Company, Chester. The first was forwarded to me by Sir James T. Stewart Richardson, Bart., of Pitfour Castle, Perth, N.B. :—

"I have been trying a new Warble ointment this summer, from the Dee Oil Company, Chester, and the effect on the maggots in the Warbles was marvellous, and I am now dressing all my cattle to prevent the Fly striking next month."

Miss Lyle Smith, writing from Barrowmore Farm, Chester, also sent the following note :—

"You may be interested to know that the Dee Oil Company, in Chester, prepare a kind of grease of which they send samples gratis to any farmer who will try it. I found it most efficacious, as did also a neighbour, who had lost a heifer simply from attack of this creature [Warble-maggot—Ed.] in the spring."

The two following letters refer especially to the benefit of the applications in preventing summer galloping, and thus allowing the animals to rest in peace.

Miss Lloyd, writing on August 6th from Hengwrt, Dolgelley, N. Wales, reported that in her own case, and that of two of her neighbours "whose cattle had been driven wild with the bites of the flies which seem to abound in the estuary of the Mowddach where our meadow pastures are, the smear was thoroughly efficacious, and allowed the animals to be peaceably grazing, while other farmers complained bitterly of the risk and loss of condition caused by these pests in their stock."

The Ven. J. C. Archdall, Archdeacon of Ferns, writing from the Parsonage, Newtown, Barry, Ireland, on June 30th, regarding the leaflets, mentioned he had delayed reply in order first "to try the effects of the suggested remedy, and I am happy to tell you with the best results.

"I have in my hands fifty acres, surrounded very much with wood; I have thirteen head of horned cattle, and I used to be obliged to bring them into the house to keep them on the land: there is abundance of water, but they were literally hunted off the pasture by the Fly. I have applied sulphur, spirit of tar, and train oil, and after one dressing the animals were freed from all persecution. I intend to apply it again in the coming week. One of my neighbours, to whom I gave a leaflet, stopped me in the street a few days since to thank me for putting him in the way of showing mercy to his cattle."

The following returns are given in tabulated form, to show the continued success of the treatment of the cattle in the district round Bunbury and Tarporley, Cheshire, by the boys of the Aldersey Grammar School. This was begun at first under the suggestion and instruction of the Head Master, Mr. W. Bailey, but now continued also from the benefit accruing to the cattle and thence to their owners. By the end of 1887 the progress was considered so satisfactory that a letter from Mr. Bailey to His Grace the Duke of Westminster, giving an account of the work of the boys, was read before Committee on December 6th, 1887, at the Royal Agricultural Society, and directed to be published, and the work since has been equally satisfactory.

The majority of the boys of the school are sons of farmers, and the returns therefore show the benefit of the treatment, whether on the broad scale of the many head of cattle owned by tenants of large farms under the Duke of Westminster or other great land-owners, or to the one or two cows of a small holder, to whom the health of his animals is even more important.

In the following table I give the names of the boys, both for exactness of record and also as a little encouragement to them in good and useful work, and likewise the number and kind of stock examined, and the number of Warbles and kind of stock on which they were found, and also whether on home cattle or on stock brought in; and it may be remarked that these returns are from a district where a few years ago Warble were, as it was phrased, as plentiful as blackberries.

The following short table was sent to me by Mr. Bailey, on March 20th (1888), as the result of examination by the boys named, on the preceding Saturday:—

NAME.	STOCK EXAMINED.	NUMBER OF WARBLER FOUND.
A. E. Willis	32 cows	1 Warble on 1 cow, and 10 on newly bought cow.
T. Jones	39 cows & 11 heifers	1 on each of 4 cows, and 15 on heifers.
C. Palin	25 cows	2 Warbles.
A. Jones	1 cow	None.
J. Williamson	2 cows	None.
C. Matthews	2 cows	1 Warble.
F. H. Willis	40 cows	Only 3 Warbles.

The following table shows results of examination a month later, on April 17th, and was also forwarded to me by Mr. Bailey:—

NAME.	STOCK EXAMINED.	NUMBER OF WARBLER FOUND.
Percy Willis J. R. Nield	82 cows and 1 heifer 86 cows	4 on one newly bought cow. 20 Warbles, viz., 8 on one cow, 2 on another, and 1 on each of 15 other cows.
Percy Allwood	57 cows	10 Warbles on four recently bought cows, viz., 4 on each of two cows, and 1 each on the other two.
Alick Dale John Wilson	57 cows & 15 calves 66 cows & 18 heifers	14 Warbles, all on calves. 18 Warbles : 8 on cow, the rest on heifers.
Thomas Y. Willis Ernest Jones	8 cows 89 cows, 11 heifers, and 6 calves	17 Warbles. 4 Warbles on cows, 15 on heifers, and 189 on calves.
Henry Garner J. H. Kirkham	2 cows and 2 heifers 8 cows, 2 heifers, and 1 calf	4 Warbles on heifer. 2 Warbles on cow, 80 on two heifers.
George Whittle	4 cows and 8 heifers	8 Warbles on one cow, and one on each of two heifers.
Joseph Proctor	8 cows, 1 heifer, and 4 calves	None on cows or heifer, 8 on one calf, and 4 on another.
Ernest Pickers Frederick Dutton Thomas E. Willis	2 cows 27 cows 25 cows	2 Warbles on one cow. 8 Warbles. 7 Warbles, all on newly bought cow.
Enoch Hunt	5 cows and 2 heifers	2 Warbles on one cow, 26 on one heifer, and 5 on the other heifer.
Joseph Stanyer	88 cows	2 Warbles on one cow.

The above total of stock examined is 515 head; the total of Warbles, 841. Looking at details, on 454 cows there were only 79 Warbles, and of these 21 were on newly bought animals; but even taking these in, if the Warbles could be divided pretty evenly it would give only one Warble and a small fraction to be divided amongst about every six cows.

On the heifers and calves the average is higher; a total of 85 heifers to 97 Warbles gives 2 and a fraction of a Warble to each heifer.

The amount on calves cannot be fairly averaged, as in one case there were 139 Warbles on 6 calves on one farm; but excluding this exceptional case, and taking the total at the other farms of 20 calves to 26 Warbles, this gives an average of 1 Warble and a fraction to each calf. The above result cannot, I think, but be regarded as highly satisfactory.

The larger amount of Warbles on the heifers and calves is presumably from the greater difficulty of application. In a note from one of the lads—Thomas Jones, of Saighton Lane, near Chester—to Mr. Bailey, he mentioned—"The heifers, through not having been tied up last year, were very difficult to hold, and therefore they were only imperfectly dressed. However, the dressing has taken some effect, for upon the backs of the eleven heifers I only found fifteen Warbles."

The following are some of the communications which have been sent me regarding serious injury to the condition of the animal, in some cases ending in death, occurring from Warble attack.

Early in May Mr. Charles Magniac, of Colworth, near Bedford, wrote me :—

"Your Lecture at the Farmer's Club suggested to me that a young steer I saw lately on my farm was dying of Warbles. I have examined him to-day, and have no doubt of it. His back is like a newly-metalled road." On May 8th I received a note from the bailiff (from the Colworth Estate Office) that the animal was dead.

On June 9th Mr. G. E. Phillips, Treriffith, Moylgrove, near Cardigan, reported without doubt of the serious nature of the attack, and I give his precise wording, as I do not know that any would be more appropriate to the misery of the feeding of more than two hundred maggots on one wretched animal :—

"These infernal maggots are something abominable this season. I and my man actually squeezed 210 out of the back of a yearling beast, and had to leave many behind; the poor creature was nothing but a mass of corruption."

Mr. M. Johnson, writing from Varmonthly Hall, Whitfield, Langley-on-Tyne, mentioned :—

"I live where it is all grazing farms, and the good work has not begun yet. Several of the cattle which were grazed on our highest land did very badly through the winter, and I could only keep them up with very good feeding. These turned out to be totally covered with Warbles. Some of the lumps when squeezed out contained nothing but a lot of sticky matter; they have got the turn now, but I firmly believe it was nothing but the Warble attack that was killing them."

I should like particularly to draw attention to the following as well as the foregoing observations, which show presence merely on *two* miserable beasts of scores more of Warbles than were found on the 515 head of cattle previously noticed (see line 9 from foot, p. 111), in the neighbourhood of Tarporley, which had been for the most part duly attended to. I can confirm the serious extent to which the attack runs on, by state of hides now before me, one of which, from a two-year old heifer, has 800—the other, from an animal which died of consequent mortification of the back, more than 400—Warble-holes in it.

On May 28th Mr. Francis Drawfield, Alton Manor Farm, Wirksworth, Derbyshire, sent me the following account :—

“In the beginning of April I had a heifer that began to lose flesh (of course she was in calf), and all the good keep and care would not prevent the flesh from going.

“She went on till the beginning of this month, when she got down and could not get up, but still kept on eating as usual.

“I had her removed into a warm paddock; I set a trough in front of her with bran, linseed-cake, and malt, which she continued to eat; I mashed her malt and put gentian root in the mash, and she drank the liquid from the mash. We left her at night to all appearance as lively as usual, but the next morning we found her dead.

“When taking off the skin, I found from the shoulders to the hips bored one complete riddle with Warble maggots.

“In counting, I found no less than 810 holes; on taking it to the tan-yard, they pronounced it good for nothing.

“There is no doubt the Warbles were the cause of death.

“It will be a great blessing for the poor cattle if something is found out to remove the pest.”

On June 16th the following note was sent me by Mr. John R. Golding, of Baunmore, Clare, Galway, Ireland, regarding serious amount of injury from Warbles :—

“Owing to the prolonged excessive heat last summer, the Warble-pest has done great injury to young cattle in this district, causing death in some instances by their numbers, from March last up to this.”

Another note on the same subject was sent me on May 15th, by Mr. Thomas Barrett Lennard, of Horsford Manor, Norwich, who wrote :—

“Many of my beasts have bumps, but one—which is so thin and wretched that he seems not long for this world—is one mass of bumps.”

The above returns are a portion only of the information sent in during 1888.

Besides the letters above quoted, I had communications weighing over five pounds with requests for the four-page leaflet, which often also conveyed accounts of the suffering, or illness, or inconvenience, or consequent money loss, caused by the Warble attack. Frequently, also, the application for information was followed after a while by another letter, with the mention that reply had been delayed until the success of the treatment advised had been proved, and now more of the leaflets were desired for circulation in the neighbourhood.

I do not claim for the treatment that absolutely no Warbles at all are to be found where care is taken, but, as will be seen by looking over the return (pp. 110—112), the amount of these on the cattle of a widespread district may be reduced, with very little trouble and expense, to no more in the total than may now be found only too often on a couple of beasts where no care has been taken.

Amongst the many reports which I have received, I am not aware of more than three in which the kind of treatment which was applied, as being *supposed* to be what is advised, failed to have good effects, and in these cases I do not feel sure that the dressing was well applied.

Where the maggots are either removed by squeezing, or by choking them with external applications (as advised in the leaflet), I am not aware of any case in which satisfactory results have not followed.

Also, so far as reported to myself, the recipe given at page 8 of my leaflet for preventing Fly attack in summer answers well; but I think it should be carefully kept before the minds of herdsmen, with regard to dressings to keep Fly off, that—though the effect of some kinds lasts a long time—it is often waste money just to run the animal over with some wash of which the effect soon goes off, especially if this is done weeks or months before Fly time.

I know, with absolute certainty, that a little dab of McDougall's smear properly applied on the tip of the tail of the maggot in each Warble-hole will kill the maggot; but I am very far from supposing that a dressing of dilute smear or dip,—either of Messrs. McDougall's or of any other firm,—if just only run over the coat in May or June, will either choke the maggots then or prevent attack later in the summer, when the time comes for the Fly to hatch out of the obrysalids.

The treatment is very simple, but it needs that the material to choke the maggot should be applied quite certainly to it, and also that the dressing to prevent Fly striking should be of a kind of which the effect lasts for a while, and should be applied when Fly is (or is likely directly to be) about.

Train oil (without any addition), applied by being rubbed down the spine and a little along the back and ribs, has been found very useful as a dressing to cattle when turned out into the fields in summer.

A mixture of sulphur 1 lb., soft soap 1 lb., and boiling water 8 pints, applied when cold with a brush to the animal's back, has also been found useful; as well as sulphur $\frac{1}{2}$ oz., prepared lard $1\frac{1}{2}$ oz., tar 1 oz. But so far as I can judge, the mixture of train oil, sulphur, and spirits of tar, noted on page 8 of my leaflets, has been found to answer best of all.

What is now needed to be done to stamp out this attack for all practical purposes is to get knowledge spread abroad of what Warbles *really are*, and what their effects are, so that, amongst other benefits, cattle buyers in country districts should not be imposed on by old-fashioned tales, long since disproved, about boils and humours, and action of the grasses, which can in a second be proved false by applying a finger and thumb to the Warble and squeezing out the great maggot.

Every man, however ignorant, has sense to know, when it is put before him, that though he may have a boil on his neck or spine he has not a great maggot in it, and if this could be impressed all round the country it would make a deal of difference.



Maggot, nat. size
about 1 in. long.

I am not aware of anything that brings the knowledge of the mischief that is going forward home to all minds better than showing the *inside* of a badly-warbled hide. Outside, the hair, &c., prevent the mischief fully showing; but when the inside is seen with the great maggots wriggling in their cells, showing their shape through the thin film to which they have worn down the lowest tissue, and the putrid matter breaking out in places, this brings conviction home that all is not "as well as could be wished."

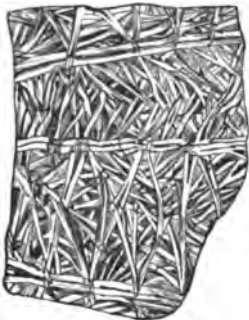
The two accompanying figures (see p. 116) show the powerful basketwork-like coating of muscles with which the maggot is furnished after its last moult within its thick skin, and the external bands of prickles. By means of the first it can wriggle itself perpetually about in its cell, and thus with the help of the prickles—which it possesses more or less through life—it keeps up a perpetual irritation.

It may be of some interest, as a specimen of how this attack is misunderstood through sheer want of information, to mention that I have a note before me of Warbles being rubbed with whale oil to bring them to a head, and then *burnt off with hot tar*. Where a man would go to this trouble and expense, and labour, to torment and injure the unlucky beast, he would have been thankful to know better.

The great points of national loss are on loss of health, and

sometimes death of the beasts, loss of milk, injury to produce in the herd, and loss of flesh in the fattening beasts. All this falls on the cattle owner, but also there is enormous loss running through all classes concerned on the warbled hides.

This strikes first, of course, where the Warbles are first observed : it may come, like the rest, on the cattle owner or farmer ; or it may come on the butcher or tanner ; or further on it comes on the many trades in which leather, discovered after purchase to be pierced, is useless for its purpose,—a loss to the manufacturer ; or a loss, or even a danger, to the wearer or user.



Muscles of maggot, much magnified.



Prickles of maggot, much magnified.

The following notes give amounts or approximate estimates of number of hides passing through various markets (specified) in the course of one year ; also amounts or approximate estimates of the proportion warbled and loss thereon.

The first I was favoured with was from Newcastle-on-Tyne :—

“ Last year (ending May, 1888) 102,877 hides passed through our markets, and of these we estimate that 60,000 were more or less warbled. Taking an average of five shillings each, which is rather under than over the mark, this gives a loss of £15,000 on our Newcastle hides from this cause for the year.”—J. MCGILLIVRAY, Secretary, Newcastle-on-Tyne Hide Inspection Society.

“ Warbles begin to show in March and continue until October. Out of 85,000 hides passing through this market within this period, I should say that one-fourth, or say 8500, would be more or less warbled, and I should estimate the money loss at from £1500 to £2000.”—W. B. WELBOURN, Secretary, Nottingham Hide, Skin and Fat Market Co., Limited.

“ Number of hides passing through our market in one year, about 80,000. Number of these that are warbled, fully one-third, or 10,000. Loss on these warbled hides, at least three shillings per hide, or a total loss of £1500 per annum. We believe the above to

be fairly near, and rather under than over the mark."—JOHN CHILD, Managing Secretary, Leeds and District Hide, Skin and Tallow Co., Limited.

"We should say that during the months of March to August inclusive there will be fully 60 per cent. of the hides more or less affected, with an estimated loss of 2s. 6d. per hide average."—JAMES WATSON & SONS, Hide Market, Whitehall Road, Leeds.

"The delay in forwarding this letter has been due to my ascertaining from our local tanners the effect of Warbles on our supply of hides.

"I have no means of ascertaining definitely, and can only approximate the following results:—

"The hides suffer most severely from March to the end of August in each year; they are slightly damaged during the months of February, September, and October; whilst during the other three months of the year they show slight traces, after tanning, by the marks left after the Warble holes have closed up.

"Taking our supply of 50,000 hides (excluding odd numbers) sold during 1888, the amount of damage on the following basis would run thus:—

	£	s.	d.
2s. 6d. per hide on 9000 hides, being one-third received from March 1st to August 31st ...	1125	0	0
1s. 6d. per hide on 2500 hides, being one-fourth received during February, September and October	187	10	0
9d. per hide on 8000 hides, being one-fourth received during November, December, and January	112	10	0
Total	1425	0	0

"Adopting another basis of calculation, taking the average to be 25 per cent. from March 1st to October 31st, and 12½ per cent. for the remaining portion of the year, and taking the damage at an average of 2s. 6d. per hide, the result would be £1250.

"I am inclined to think that both these estimates considerably under-rate the mischief done, and would especially point out that these figures refer only to the deterioration to the sale of the hides in a green state, and do not take into account the loss to the tanner on the finished article being depreciated in value, or the cost of labour and materials expended in producing leather which when finished is found to be unfit for the purpose intended.

"Another very important matter is the deterioration of the animal

whilst living." &c.—W. H. HULL, Manager to the Sheffield Butchers' Hide and Skin Co., Limited.

"I should say" the Warble "makes from a farthing to sometimes a penny per pound difference to the butcher (about four or five shillings each hide difference)."—From a communication on the general bearing of the subject, by Mr. JOSEPH WING, Hide, Skin and Fat Broker, 16, Pen Street, Boston.

"Re Warbles, we give you particulars as far as possible. The number of hides sold in the Hide-market in Liverpool and the American Lairage in Birkenhead is about 180,000 per year: this is exclusive of hides under 80 lbs., which we call Kips.

"We reckon the warbled hides to be—in the month of February, 20 per cent.; in March, 45 per cent.; in April, 80 per cent.; and in May, 20 per cent.

"The average weight of the above 180,000 we calculate at 65 lbs. each, and the loss in price at three farthings per pound."*—MESSRS. WHINATES, WEBSTER, McNAUGHT & Co., Hide, Skin and Fat Brokers, The Market, Gill Street, Liverpool.

"I regret I am unable to give you any *reliable* information respecting warbled hides, as in this neighbourhood we have never kept a separate class and account of them.

"Here we have thrown them into the same class as cut hides and damaged hides, and previous to some years ago we passed them as sound hides unless they were badly warbled.

"The Bristol slaughter of beasts would be about 700 per week, and during the summer and autumn months fully one-third of this number would be warbled. Some of the heavier hides would lose in consequence ten shillings per hide, and even more; but taking the heavy hides and light hides together, their average loss would be not less than five shillings per hide."†—WILLIAM WILLIS, Bristol and Western Counties Butchers' Hide and Skin Co., Limited, 88, Thomas Street, Bristol.

"In our market we have a system of inspection for all market hides, being hides of cattle slaughtered in Glasgow and neighbourhood for food purposes only. Under this system the hides are classified,—first and second classes, the latter being faulty flayed, and warbled hides.

* "We handle large numbers of horse-hides, and we never saw a warbled horse-hide."

† "Taking the above estimate of 700 hides per week, would give 86,400 in the year, and 12,133 for four months (say) May to August inclusive. One-third of this amount, that is 4044 hides, estimated to be warbled at a loss of five shillings per hide, would show a loss of £1011."

“ Referring to enclosed sheet you may note that in 1888 the total number of such hides have been 104,551.

Total Market Hides.

1888.		Firsts.	Seconds.	Totals.
January	... ..	5820	8861	9181
February	... ..	5476	5892	11368
March	... ..	8541	4559	8100
April	... ..	8582	8922	7504
May	... ..	8229	5618	8847
June	... ..	8144	8770	6914
July	... ..	8288	8281	6514
August	... ..	5020	8728	8748
September	... ..	4857	8084	7941
October	... ..	7228	8451	10679
November	... ..	6747	2647	9894
December	... ..	6811	2550	9861
Total	... ..	58788	45818	104551

“ Taking the Warble months as February to May inclusive, we find the proportion of second class to be 56 per cent., while from June to December the proportion is only about 86 per cent., being, on a fair calculation, an increase of 20 per cent. on account of Warbles.

“ If we then take the number slaughtered in February to May as about 86,000, we find 20 per cent. on that number yield 7200 warbled hides: damaged by Warbles to the extent of (say) one penny per pound, at an average of 60 lbs. per hide, shows £1800 as the loss thus incurred.

“ Further, we may legitimately add that, as the cost of manufacture is the same as for sound hides, the loss to the community or national wealth will show double the amount, or in round numbers a loss of £4000 annually in the district.

“ No account is here made of Irish and country hides, of which we pass about 50,000 annually, and among which the damage is probably in a higher ratio than the others.”—Messrs. ROBERT RAMSEY & Co., Auction Brokers, Hides, &c., Greendyke Street, Glasgow, N.B.

The following Table, with which I am favoured by Messrs. W. Murray and Son, of Aberdeen, gives the number of sound hides, and number of warbled hides, and estimated loss per week thereon from February 8rd to June 29th inclusive, and includes all the hides in Aberdeen, *viz.*, those of Messrs. Murray and those sold by the Cooperative Company.

Estimated Loss by Warble on Hides passing through Aberdeen Market from February to June, 1888, inclusive.

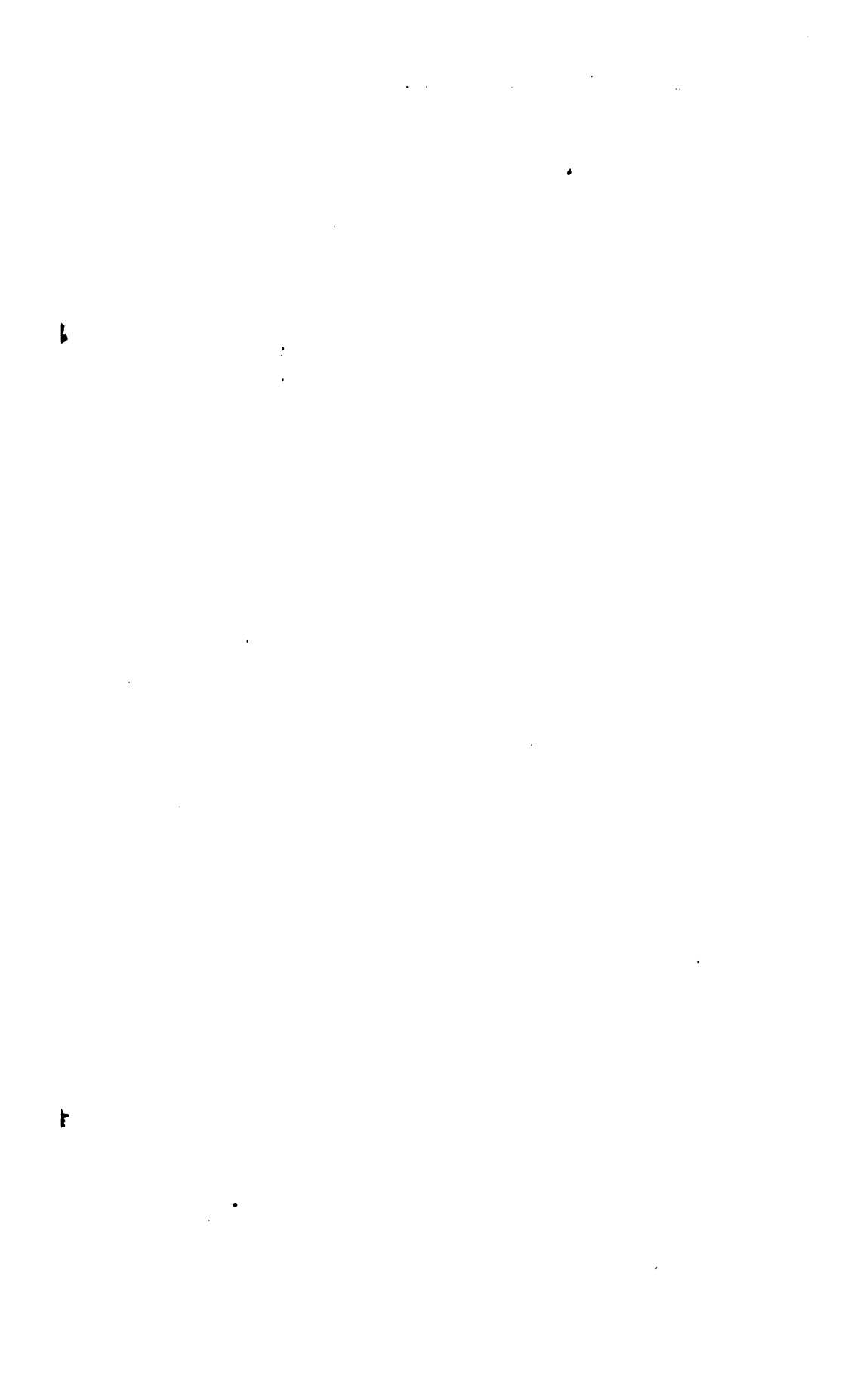
Week ending	Number of Sound Hides.	Number of Warbled Hides.	Estimated Loss per Week.		
			£	s.	d.
February 8 ...	2844	418	80	19	9
„ 10 ...	2800	448	85	16	7½
„ 17 ...	2454	478	91	12	10½
„ 24 ...	2874	501	97	1	4
March 2 ...	2641	569	110	4	11
„ 9 ...	2124	611	118	7	7½
„ 16 ...	2249	602	116	12	9
„ 23 ...	2187	719	189	6	1½
„ 30 ...	2095	718	189	2	8
April 6 ...	2181	750	145	6	8
„ 13 ...	2207	755	146	5	7½
„ 20 ...	1699	705	186	11	10½
„ 27 ...	2021	640	124	0	0
May 4 ...	2808	755	146	5	7½
„ 11 ...	2257	754	146	1	9
„ 18 ...	2076	875	169	10	7½
„ 25 ...	1660	664	128	18	0
June 1 ...	2091	916	177	9	6
„ 8 ...	1981	747	144	14	7½
„ 15 ...	1948	771	149	7	7½
„ 22 ...	1685	751	145	10	1½
„ 29 ...	1446	698	184	5	4½
Total for 5 months ...	46278	14880	2878	6	8

“Being about 25 per cent. of total number of hides affected by Warble.

“Average depreciation calculated at ½d. per pound. Weight of hides principally affected, 50 to 70 pounds.”—Messrs. WILLIAM MURRAY & SON, George Street, Aberdeen, N.B.

To the above returns I append the following Tables, with which I was favoured respectively in 1884 and 1885 through the courtesy of Messrs. Fry & Co., Leather and Hide Factors, of Moor Street, Birmingham, which show how the amount of loss may be calculated to a nicety at markets where warbled hides are “outclassed.”

The following Table, it will be seen, does not include the three classes known as “heavy” and “light” cows’ hides, and bulls’ hides which also were warbled. In this Table the results of calculation of loss on the six classes of hides only are given; in the succeeding Table the cows’ hides are included, and the particulars are given week by week in detail from February 14th to September 19th.



Particulars of Sound and Warbled E^{mon}, viz.,

		of the and upwards.	Price.	Total Sound.	Warbled.	Price.	of 25 to 34 lbs.	Price.	Total Sound.	Warbled.	Price.	Light Corn.	Price.	Total Sound.	Warbled.	Price.
Feb. 14	O	11	5	44	1	4½	29	4½	52	1	4½	54	4	63	0	
	X	38	5½				28	5				41	4½			
" 21	O	15	5½	30	1	4½	9	4½	26	2	4½	6	4½	47	3	3½
	X	15	5½				17	5½				43	4			
" 28	O	20	5				22	4½	32	5	4½	9	4½	52	3	3½
	X	18	5½	38	2	4½	10	5½				49	4			
March 7	O	23	5½				16	4½	27	10	4½	6	4½	55	7	3½
	X	9	5½	32	4	4½	11	5½				44	4			
" 14	O	16	5½				15	4½	37	10	4½	10	4½	54	5	3½
	X	14	5½	30	6	4½	22	5½				40	4½			
" 21	O	9	5½				21	4½	28	11	4½	4	4½	44	6	3½
	X	12	5½	21	3	4½	7	5½				43	4½			
" 28	O	12	5½				6	4½	28	11	4½	6	4½	49	9	3½
	X	18	5½	30	8	4½	17	5½				28	4			
April 4	O	14	5½				20	5½	27	16	4½	5	4½	33	9	3½
	X	10	5½	24	6	4½	7	5½				27	4			
" 11	O	10	5½				17	4½	29	9	4½	4	4½	31	5	3½
	X	19	5½	23	9	4½	12	5½				32	4			
" 18	O	16	5½				18	5	30	18	4½	2	4½	34	10	3½
	X	8	5½	24	11	4½	12	5½				34	4½			
" 25	O	12	5½				16	5	29	9	4½	0	4½	34	12	3½
	X	11	5½	23	1	5	13	5½				33	4½			
May 2	O	9	5½				27	5½	37	14	4½	6	4½	39	5	3½
	X	6	5½	15	2	5½	10	5½				39	4½			
" 9	O	15	5½				28	5½	34	7	4½	5	4½	44	5	3½
	X	6	5½	21	4	5½	6	5½				31	4			
" 16	O	5	5½				18	5½	20	4	4½	9	4½	40	9	3½
	X	10	5½	15	5	5	7	5½				25	4½			
" 23	O	5	5½				23	4½	40	2	4½	6	4½	31	8	3½
	X	9	5½	14	3	4½	17	5½				21	4½			
" 30	O	15	5½				15	4½	19	4	4½	7	4½	28	5	3½
	X	4	5½	19	2	4½	4	5				25	4			
June 6	O	6	5½				6	4½	14	2	4½	4	4½	29	6	3½
	X	6	5½	12	0		8	5½				38	4			
" 13	O	3	5½				13	4½	20	4	4½	2	4½	40	7	3½
	X	2	5½	5	0		7	5½				27	4			
" 20	O	2	5½				8	4½	14	1	4½	4	4½	31	5	3½
	X	2	5½	4	0		6	5½				29	4			
" 27	O	2	5½				7	4½	15	1	4½	4	4½	33	9	3½
	X	1	5½	3	0		7	5½				42	4			
July 4	O	8	5½				11	5	26	0		5	4½	47	3	3½
	X	4	5½	12	0		15	5½				39	4			
" 11	O	6	5½				8	5½	20	1	4½	5	4½	44	8	3½
	X	10	5½	16	0		12	5½				36	3½			
" 18	O	5	5½				9	5½	21	0		8	4½	44	4	3½
	X	5	5½	11	0		12	5½				40	4			
" 25	O	5	5½				8	5½	20	0		4	4½	44	5	3½
	X	6	5½	11	0		12	5½				42	3½			
Aug. 1	O	1	5½				9	5½	25	1	4½	8	4½	45	3	3½
	X	15	5½	16	0		16	5½				27	3½			
" 8	O	2	5½				11	5	32	0		2	4½	29	1	3½
	X	7	5½	9	0		21	5½				40	3½			
" 15	O	2	5½				12	5	34	0		4	4½	44	2	3½
	X	14	5½	16	0		22	5½				37	3½			
" 22	O	4	5				17	4½	30	0		11	4½	48	2	3½
	X	13	5½	17	0		18	5				52	3½			
" 29	O	6	5½				17	4½	31	0		4	4½	56	0	
	X	15	5½	21	0		14	5½				55	3½			
Sept. 5	O	7	5½				21	4½	44	0		9	4½	64	0	
	X	13	5½	20	0		23	5½				40	3½			
" 12	O	8	5½				17	4½	32	0		6	4½	46	0	
	X	11	5½	14	0		15	5½				50	3½			
" 19	O	9	5½				22	4½	43	0		10	4½	60		
	X	16	5½	25	0		21	5								
32 weeks.				621	68				911	138				1882	151	

O for ordinaries.

"Particulars of seven weeks' supply of six classes of hides, being the total of each class of sound and warbled sold at two markets in Birmingham, commencing May 8rd up to and including June 14th, 1884, and showing the actual loss of each class of warbled hide:—

*Hides.**

Six Classes of Hides, Weight from—	No. of Sound.	No. of Warbled.	Sold at, less than the Sound—		Loss on each Class.		
			Per lb.	Per hide.	£	s.	d.
95 lbs. and upwards	286	67	$\frac{1}{2}$ d. or	6s. 8d.	20	18	0
85 lbs. to 94 lbs. ...	446	222	$\frac{1}{2}$ d. „	6s. 7d.	78	1	6
75 „ 84 „ ...	754	378	1d. „	6s. 8d.	124	6	8
65 „ 74 „ ...	881	579	1d. „	5s. 10d.	168	17	6
56 „ 64 „ ...	629	441	1d. „	5s.	110	5	0
55 lbs. and under...	288	224	1d. „	4s. 8d.	47	12	0
Totals ...	3279	1908			545	0	8

"It will be observed that of the total number of hides (*viz.*, 5185) over one-third were warbled; and looking merely at one line of the figures, it shows that out of 1460 hides, ranging from 65 to 74 lbs. weight, 579 were lessened in value at the rate of 1d. per pound, or 5s. 10d. per hide, giving a total loss on these of £168 17s. 6d."

The accompanying Table, with which also I was favoured by Messrs. Fry & Co., of Birmingham, gives particulars of the numbers of sound and warbled hides sold at one of the Birmingham markets, and the price each parcel sold at, from the beginning of the warbled season, *viz.*, February 14th, to the end, September 19th, in 1885.

"These details, it will be seen, extend over a duration of thirty-two weeks, and include price per pound of "ordinary" and "extra flayed" hide (marked down the third column as "o" and "x" respectively), as well as of those which are warbled.

"By casting the eye along the columns it will be seen that the first three heavy classes, namely, those of 95 lbs. and upwards, 85 to 94 lbs., and 75 to 84 lbs., which are all or nearly all ox-hides, do not suffer as much as the three following. These last—that is, the classes weighing 65 to 74 lbs., 56 to 64 lbs., and 55 lbs. and under—are principally heifer-hides, and are the greatest sufferers. Bulls' hides are stated, as a rule, to be also very much warbled, but as these are not what is

* The above Table was given in my Eighth Annual Report of Observations of Injurious Insects, and the Table next following in my Report of the succeeding year (Ninth Report; Simpkin, Marshall & Co., publishers); and with these, as bearing very practically on the subject, I reprint some parts of the explanation of the Tables, and information with which I was then kindly favoured by Messrs. Fry and Co., Birmingham.

termed "thrown out," but sold (sound and warbled) together, the proportion of warbled hide could not be given.

"The following abstract of the larger Tables is given for convenience of reference. The amount sold during the thirty-two weeks of sound and of warbled hides may thus be conveniently compared, together with the highest and lowest prices per pound of each. The sound hides include both the ordinary and the extra flayed.

Abstract of Table overleaf, with particulars of different classes of Hides sold during warbled season of thirty-two weeks from February 14th to September 19th, 1885.

Weight and Description of Classes of Hides.	No. of Sound Hides.	Highest and Lowest Prices per lb.	No. of Warbled Hides.	Highest and Lowest Prices per lb.
95 lbs. and upwards	621	5d. to 6d.	68	4½d. to 5½d.
85 lbs. to 94 lbs. ...	911	4½d. „ 5½d.	188	4½d. „ 4½d.
75 „ 84 „ ...	1495	4½d. „ 5½d.	306	4d. „ 4½d.
65 „ 74 „ ...	1789	4d. „ 4½d.	541	3½d. „ 4½d.
56 „ 64 „ ...	1692	3½d. „ 4½d.	497	3½d. „ 4½d.
55 lbs. and under ...	878	3½d. „ 4½d.	305	3½d. „ 4½d.
Heavy cow-hides ...	1198	8½d. „ 4½d.	140	8½d. „ 4d.
Light cow-hides ...	1882	8½d. „ 4½d.	151	8½d. „ 8½d.
Totals ...	9956		2146	

"Careful study of the detailed (folding) Tables is well worth while for those practically interested. They show the different time over which attack extends from February 14th, and that it certainly cannot be considered as stopping in July. We find it in the three lighter classes of hides as still present on September 19th, but it is worth some notice that three heavy classes did not contain warbled hides at a much earlier date. The heaviest ox-hides, 95 lbs. and upwards, were free after May 30th, and the two others of these heavy classes were free (save two hides in one class and one in the other) respectively after June 27th and July 18th.

"It may also be seen that sometimes, at what may be called the height of the warbled season, the number of warbled hides exceeds that of the sound in some of the classes. On April 25th entries occur amongst the "65 to 74 lbs." and the "55 lbs. and under" hides respectively, of sales of 42 warbled to 88 sound, and 25 warbled to 9 sound."

The above returns convey information, more or less full as the case may be, from Hide-markets at Aberdeen, Birmingham, Boston, Bristol, Glasgow, Leeds, Liverpool, Newcastle-on-Tyne, Nottingham and Sheffield;* and a glance at the sum totals of warbled hides, and

* That from Manchester is appended at p. 125 for reasons there given.

calculations of loss thereon, will give some idea of the loss and waste of material that is going on, but very far from a full one. The returns show depreciation of market value, but it should also be considered (as pointed out by Messrs. Ramsey, of Glasgow, and Mr. Hill, Manager of the Sheffield Butchers' Company) that this loss is quite independent of the subsequent waste of money consequent on the expenses of manufacture of damaged material, which, when finished, may be useless for the purposes needed.

Messrs. Ramsey's approximate estimate of this gives about double the original loss on the injured hides as the amount thus wasted to the community,—that is, to the national wealth.

But further, although the bulk of the English hides are distributed from the Hide-markets to the Tanneries, there is still no small amount received directly by tanners, from local farmers or butchers.

On my application to Messrs. C. & H. Hatton, of the Barton Tannery, Hereford, as to their estimate of the loss suffered by themselves from Warble injury, they drew my attention to this point, and added:—

“We venture to think it would be sufficient to state that one-half of the hides taken in by tanners direct from the butchers are warbled, and show an average loss of 5s. to 6s. each: this would, of course, show a rough estimate of some thousands of pounds in the United Kingdom, independently of the numbers declared from the markets, and we regret to say that many hides which are classed as perfect on the market prove to be covered with minute Warble-grubs when the flesh and hair are removed by the tanner.”

The reason of the high estimate of loss on local hides is obvious, as it includes those of animals which have died from various causes, amongst which in spring there is a coincidence of such great amount of Warble presence as to point to this being often the real cause of death.

From Hereford Messrs. Hatton have sent me reports of the horrible state of Warble infestation in hides brought in of cattle *stated* to have died of “black-leg,” but which they considered to have died from Warble attack. On one occasion five of these hides were brought to them in four or five days, all *stated* to have died of “black-leg” or “quarter evil,” and all similarly warbled. One piece of hide sent me as an example, measuring 28 inches long by about 8 inches wide, contained 72 Warbles.

From Mr. W. Williams (tanner), of Haverfordwest, I have recently heard (when writing regarding distribution of leaflets):—

“I should make a point of giving a copy to each farmer when paying him for his dead hides, of which great numbers come in every spring with their backs in a mass of jelly from Warbles. I have

sometimes pointed out cases where the Warbles were sufficient to cause death, but the farmers will not believe it, and say it was inflammation of the kidneys."

It is not for me to offer an opinion on veterinary points, but it appears to me that such coincidence of a deranged state of system with the existence of the great amount of inflammation, and also of putrid matter, in the hide, is a matter asking for investigation.

I have by me a hide of a yearling that was known to die clearly from mortification caused by Warbles; also last summer, through the courtesy of Prof. Wortley Axe, of the Royal Veterinary College, Camden Town, who at my request examined for me the heart of a runt which was warbled (not specially largely, but just along the course of the spine), it was found that blood-poisoning was certainly coincident with the sudden death of the animal; and I have many other notes showing the illness, even up to death, in bad cases of warbles.

Loss on the hides is a very serious matter, but it should be remembered that this is only a part of the loss caused by Warble attack: in the words of Mr. R. Stratton, of the Duffryn, Newport, Monmouthshire, "it is as pennies to sovereigns" compared to the loss on the animals.

The Hide returns show the effect of *one season's* attack, but the animal has suffered, according to its age, repeatedly, as in an instance lately sent me by Messrs. Thomas & Sons, of Llandilo, who reported that on one old cow-hide "there were 500 scabs," these showing the injuries of Warble in former seasons.

No one who gives a little thought to the subject can fail to see that the attack is a very bad thing to allow, in whatever way it is looked at. It is bad *for the animal* that it should be in pain, both for itself and because this prevents its thriving; and it is *very bad for the owner* that the running sores in the hide, which serve to support maggots an inch long, which may be counted often by scores and sometimes by hundreds, should draw away a percentage of the returns of the food meant to support the animal on whose juices they feed; and no one connected with cattle will doubt that for the herds to tear about the fields full drive in the summer heat, is very bad indeed for profit to the owner, whether in meat, milk, or coming produce.

The point we need to undermine, to get proper attention paid, is mainly IGNORANCE, and especially we need to show that the attack is not "boils"! but a swelling as big as a bad boil, with the addition of a great maggot screwing itself about by its rings inside; and it might fairly be put to any man who upholds the benefit of the attack, how he would feel if he had even only a score of large boils along his back, even without a maggot (a worm as it is sometimes called—a very type of utter misery) feeding for months on his living frame,

The thing of all others that we find answer to bring conviction is just to let all concerned *see for themselves* what is going on. When the hide is on the animal the mischief is very much hidden by the hair ; but when the hide is displayed after death, then its loathsome condition, with the maggots working in it, shows the state of the case, and removes all possibility of it being considered either to be good for the animal, or to be caused by "boils" !

Another point needed is distribution, in short plain form, of information as to the nature of the attack, and also as to how easily it may be checked. During the last few years many thousands of the four-page leaflet, of which a sample is given following this Report, have been distributed, and I should be happy to continue to send them gratuitously to all interested in prevention of Warble attack, and also to endeavour to give all information in my power to those who may apply to me on the subject.

ADDENDUM.

When this sheet was in type I was favoured by the following valuable information from Messrs. Richard Markendale & Co., Manchester. I therefore place it separately as an addition to the preceding returns of loss on warbled hides, given at pp. 116—124 ; but in any case I think it would have been well that it should stand alone as an especial example of the serious amount of the loss which is now going forward. A return showing over 88,000 hides damaged by Warble, and loss thereon of over £16,000 in one year, is a matter for serious consideration.

The return I am favoured with is as follows :—

" March 6th, 1889. Further to yours of January 14th, 1889, *re* numbers warbled, and loss of hides passing through this market in one year. We now have much pleasure in sending you the information.

" 1888. Jan to Dec. Number of hides, 250,740 total.

" " " " 88,580 warbled.

" Loss on same, £16,716 for one year."

—Messrs. RICHARD MARKENDALE & Co., Limited, Hide, Skin and Fat Market, Manchester.

APPENDIX.

TURNIP FLEA-BEETLE AND STRAWSON'S AIR-POWER DISTRIBUTOR.

DURING the past year much attention was drawn by the Agricultural Journals to the implement known as "Strawson's Air-power Distributor," or "Pneumatic Drill," which, so far as experimental trials showed, and especially those made at the College of Agriculture at Downton, appeared likely to be serviceable for various farm purposes, and, amongst others, likely to meet a great need as a means of distributing dressings obnoxious to insect life, over a larger area, more rapidly and far more completely than could be done at a paying rate by hand.

The experiments showed the methods of application to be very excellent; but with regard to the practical effect in checking attack of Turnip Fly or Flea Beetle (which is one constantly recurring summer want), as this could only be judged of by field-work, I made enquiry as to where Turnip-crops infested by "Fly" had been subjected to the action of the dressings thrown by the Distributor, and was favoured, on my request for information, with the two following notes of successful work on badly infested fields,—one by Mr. W. Geo. Mount, M.P., of Wasing Place, near Reading; the other from Mr. Geo. Budd, of Mousefield Farm, near Newbury.

In the case of Mr. Mount's Turnips I am informed that the dressing was given early, about 8 a.m., or earlier; and regarding results Mr. Mount was good enough to reply to my enquiry, on January 28th, from Wasing Place, as follows:—

"I understand that you wish to know the result of a trial of the air-power machine invented by Mr. Strawson, of Newbury, in checking the ravages of the Turnip Fly. I sowed some Swedes on nine acres of land in May last year. Early in June the Fly was strongly upon them. I obtained the use of Mr. Strawson's machine, and dressed part of four acres in the field with lime, part with paraffin; both remedies seemed to be equally efficacious, and I shall certainly use it again this year if necessary."

At Mr. Budd's farm the dressing was applied in the evening, and was, as above, of paraffin, also of paraffin mixed with lime, the Fly attack being very bad at the time. Regarding success of this application Mr. Budd replied to my enquiry as follows, on January 25th, from Mousefield Farm, Newbury:—

"I beg to inform you that I found great benefit from Strawson and

Co.'s Distributor, as where I had not used it I had to drill for Turnips again : it was a great prevention to the Fly, and enabled me to feed off a very early crop."

The great point in method of distribution of dressing which makes the apparatus (as far as is at present shown) appear likely to meet many insecticide needs is, that, by means of a tremendous blast of air obtained by a gearing from one of the driving-wheels of the machine, the dressing, whether dry or wet, can be sent up in a cloud-like smoke or mist, of such fineness that when it settles on the leaves it covers the surface completely and delicately, like a fine hoar frost or fine spray. Thus all the exposed surfaces can be lightly and thoroughly covered, and the insects also struck much more effectually than in hand-dressing; and further, I am informed that the underside also of the leaves may be reached by the powerful current of air (and whatever the air is made to carry with it) which can be thrown from the Distributor.

The machine is drawn by one light horse, and is stated to be worked easily and without troublesome details, and if on continued trial it should be still found as successful in checking Turnip Flea Beetle it would be of great service; but I particularly mention the subject here as it appears possible that some form of the application might be brought to bear on the Aphis attack (sometimes known as 'Green Fly'), which often in autumn destroys whole fields of Turnips by coating the leaves with myriads of these 'Aphis Flies' or 'Lice' in all stages, and making the plants one mass of filth.

Hitherto it has appeared totally impossible to clear the plants; but if only the matter could be arranged of possibility of the implement being drawn to and fro amongst the Turnips, then there would be every hope of clearing the insects. According to description of the action of the implement the usual insecticide dry-dressings could easily be given, or, if desired, a good current of moist dressing or of water (which in the case of this Aphis attack would be very effective) could be driven at the plants, and the masses of filth be cleared away.

All details of the action of the implement have been placed before the public in the Agricultural Journals, but notes of practical results of trial on infested land would be very desirable, and might prove of much agricultural benefit.

WHEAT-FLOUR MOTH.

"WHEAT-FLOUR MOTH," *Ephestia Kuhlmanni* (pp. 66—72). — On making further enquiries relatively to the presence of this flour-pest at the Mediterranean ports, I am informed that it is prevalent there

where the highly "glutenous" Russian and Hungarian Wheats are used. My correspondent, who has had much experience in watching the workings of the caterpillar, considers its presence in these to be attributable to a great amount of gluten suitable for the food of the larvæ being present in these Wheats. I cannot myself say how this may be, but as—at first sight at least—the presence of the caterpillar might appear attributable to its being exported from the country where the Wheat grows which it frequents, I wrote to Dr. Charles Lindeman, of Moscow, who is excellently acquainted with the crop-pests of Russia, to enquire whether he could favour me with any information as to presence of this attack in Russia or Hungary.

Dr. Lindeman was good enough to reply at once that he was not aware of its presence in Southern Russia, but that in Central Russia he could take upon himself to state that this insect had not up to the present time been observed. Further, Dr. Lindeman informed me that Dr. Sorhagen, of Hamburg, and other Lepidopterists (*i. e.*, observers of this order of insects), consider this moth has been imported to Europe from America.

As it might prove of great service in preventing this pest settling in our Wheat-mills, or stores, to know from what country to look for its transmission, I have, on receipt of Dr. Lindeman's information, written to Prof. Riley, Entomologist to the Department of Agriculture, U. S. A., requesting him to let me know whether he was acquainted with it as a flour infestation, and if so whether any means were found available for prevention or remedy of its ravages, and powers of clogging mill-apparatus.

From Prof. Riley's immense information and great courtesy I have no doubt he will favour us with as full a reply as may be in his power, which, with his permission, I shall at once give all serviceable points of for public use.—E. A. O.

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NOTES ON OX WARBLE FLY, OR BOT FLY,

Hypoderma Bovis, De Geer.



1, OX WARBLE FLY; 2, maggot; 3, chrysalis.

THE OX WARBLE FLY, or BOT FLY, is a two-winged fly, upwards of half-an-inch in length, so banded and marked with differently-coloured hair as to be not unlike a Humble Bee. The face is yellowish; the body between the wings yellowish before and black behind: and the abdomen whitish at the base, black in the middle, and orange at the tip. The head is large; the wings brown; and the legs black or pitchy, with lighter feet.

The female is furnished with a long egg-laying tube; but whether she inserts her eggs into the hide or lays them on it has not been made out with certainty.

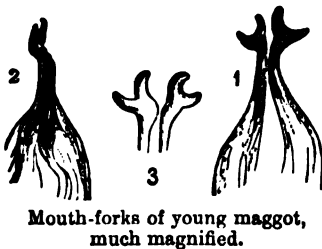
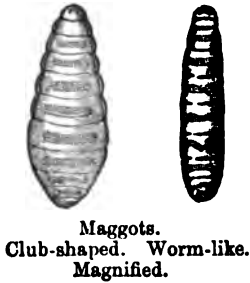
Egg-laying takes place *during the summer*; it may begin in the month of May, but the time varies with the weather, and with the cattle being on low land or hill pastures, and other circumstances. The egg is oval and white, with a small brownish lump at one end.

When full-grown the Warble-maggot is the shape figured above.

The mischief may first be found on the flesh side of the hide early in the winter. Specimens received from Messrs. Hatton, Hereford, on November 18th, showed the first appearance as small swellings bluish in colour, as if half a large shot was under the skin, and much inflamed round. The maggots were very minute and blood-colour, and lying free (not in a cell) with a fine channel down through the hide to where they lay.

The open Warble was first found towards the end of January, and by the end of February open Warbles were noticeable in many places, and the maggot was now white (not being feeding in bloody matter), worm-like, and with strong mouth-forks; in its next stage it was club-shaped, and had a power of inflating itself by drawing

in fluid until it was almost as hard and transparent as ice, and, lying small end uppermost, thus kept pressing the opening through the hide larger. In its next stage it gained its well-known shape, with a thicker and more prickly skin, the Warble-cell at the same time gaining its membranous coating.

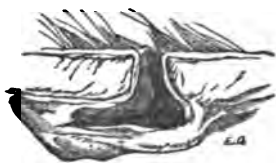


The maggot can move up and down, but commonly has its brownish-tipped tail at the opening, and it draws in air through breathing-pores in these brown-black tips or spiracles. The mouth-end is down below, feeding in the ulcerated matter caused by irritation from perpetual suction of the mouth parts. The maggot cannot protect itself from the effect of applications, therefore anything put on the opening where the breathing tips show will choke the breathing apparatus, or run down into the hole and poison the maggot. The earlier this is done in the season the better it will be for the animal, and the less difficulty there will be in the Warble-holes healing.

Whilst the maggots are in the Warbles, though a skin-like membrane forms round the surface of the perforations (see figure, page 8), they cannot heal up because the maggot lies within; and when the Warble-grub has *fallen out*, though the hole contracts, the surfaces, being already covered with a film of tissue, are slow to unite; and, as may be seen in warbled hides, union is often prevented by this skin-like film shelling off, and laying with dried matter in the perforation. On

the under side of the hide, though the *surface may not* be broken, yet the subcutaneous tissues are often left as a mere film of no strength, which injures the surface of the leather.

When the maggot is full-grown it is about an inch long and dark grey; it presses itself out of the opening tail foremost, and falls to the ground, where it finds some shelter, either in the ground or under a stone or clod, where it changes to a chrysalis. The chrysalis is dark brown or black, much like the maggot in shape, only flatter on one side; and from this brown husk the Warble Fly comes out in three or four weeks, but this length of time is increased by cold weather.



Section of Warble, after soaking in water.

With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the Warble-maggot easily and cheaply, when the Warble has "ripened"—that is, opened so far that the black end of the tail is visible. Then it may be destroyed cheaply and quickly. From special observations, taken during the last three years, it has been found that where the Warble-maggots have been destroyed before they drop from the cattle, there is little if any summer attack of Warble-flies. Consequently the cattle can rest in peace, and, as there is very little egg-laying on them, there are scarcely any Warbles in the following spring.

Squeezing out the maggots is a sure method of getting rid of them, but they may be destroyed easily and without risk by dressing the Warble with a little of McDougall's smear or dip, or by a little cart-grease and sulphur, applied well on the opening of the Warble. Mercurial ointment answers, if carefully used—that is, in very small quantity, and only applied *once* as a *small* touch on the Warble; but where there is any risk of careless application it should not be used. Any thick greasy matter that will choke the breathing-pores of the maggot, or poison it by running down into the cell in which it lies and feeds, will answer well; and lard or rancid butter mixed with a little sulphur has also been found to answer. Tar answers if carefully placed, so as to be absolutely on the hole into the Warble. Bought cattle are often badly infested, and need attention.

To prevent fly attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a-week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce.

A mixture of spirit of tar, linseed oil, sulphur, and carbolic acid, has also been found useful; and anything of a tarry nature is useful, as sheep-salve (or bad butter and tar mixed with sulphur), or Stockholm or green tar, rubbed on the top of the cows' backs between the top of the shoulder-blade and loins. Washes of

a strong pickling brine, applied two or three times during the season, are very useful. Paraffin and kerosine are useful for a time, but the smell goes off before very long.

Where cattle are suffering badly from Warbles, so that the health is clearly affected, and the animal wasting, the use of the well-known old "black oils" has been found to do much good.

Mr. Hy. Thompson, M.R.C.V.S., of Aspatria, Cumberland, gives the following recipe used for a bad case:—"Turpentine, 1½ oz.; sulphuric acid, 1 drachm (here a chemical action sets in and must be done with caution). To this I added 10 oz. raw linseed oil, and rubbed the cow's back once a-day with the mixture. . . . In a fortnight the back was cleaned and all the maggots destroyed."

There are many other points that bear on prevention, of which one is—noting that Warble Flies are *most active in heat and sunshine*, and appear *not to pursue cattle over water*; consequently allowing the cattle the power of sheltering themselves, and access to shallow pools, is desirable. Likewise with regard to pastures, or standing-ground of infested cattle, it is matter of course that where the maggots *have fallen from their backs the Flies will shortly appear to start new attacks*.

Warble attack is one of the few in which each owner benefits surely by his own work.

The attack of Warbles is now grown to be one causing enormous annual national loss, estimated by practical men at sums from *two millions to seven millions pounds sterling per annum*, at the least. There is no sort of reason why we should suffer it to go on; and the reports sent in from cattle owners in Great Britain and Ireland during the last three years show the ease with which the attack may be checked, and the great consequent gain to owners. Any applications to myself on the subject will receive immediate and most careful attention, and any information would be gladly received.

ELEANOR A. ORMEROD,
*Consulting Entomologist
to the Royal Agricultural Society.*

TORRINGTON HOUSE, ST. ALBANS,
May, 1888.

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